ANGKOR VAT

INDIA'S CONTRIBUTION IN CONSERVATION

1986-1993

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1986-1993

B. NARASIMHAIAH

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Dedicated to the ancient and everlasting
cultural bonds between
peoples of India and Cambodia (Kambujadesa)

FOREWORD

Travelling on the "Magic Ship" in 1926, Rabindranath Tagore saw the grandeur of the vast culture of south-eastern and eastern Asia. At Borobudur, Bali, Java, Thailand and Cambodia, he was struck by the deep and enduring affinity that these countries had with India. In mellifluous verse, Tagore captured in his poem 'Sagarika' the rich and vibrant past which bound these nations together.

Trade took in its wake, the culture of India to her eastern neighbours. The temples of southern and eastern India bear close resemblence in style and inspiration to those of south-eastern Asia. India too was enriched by the cross-fertilisation of ideas from these societies. Hinduism, Buddhism, art, sculpture, spices, silk, gold and pearls travelled in "the jewelled ships" which Tagore mentioned in his poem.

This rich and peaceful intermingling was destroyed in the middle ages when various invasions disrupted these societies. The jewelled ships ceased to sail and the great monuments chiselled into splendour were abandoned and covered by forests.

As in India, so too in Cambodia, officers of the colonial era chanced to discover the forgotten treasures in stone. As Burgess discovered Ajanta so Henri Mahout discovered Angkor Vat four centuries after it fell to the forests. It took another century before earnest efforts were made to restore the grandeur of Angkor Vat. The Ecole Francaise Extreme Orient was established in 1900 when the French archaeologists in Indo-China took up conservation of this vast temple complex, utilising the documentation done in earlier decades. The onset of civil strife in the 1970s disrupted the French restoration efforts. In 1980, Prince Norodom Sihanouk made appeal to the comity of nations, seeking assistance for restoration of Cambodia's greatest architectural treasure.

Cambodia had emerged from colonial and civil wars and wanted this temple complex to be restored since this monument is the national symbol of Cambodia. Responding to this appeal, the then Prime Minister Smt. Indira Gandhi offered to send experts to assist in the effort to preserve Angkor Vat. After preliminary explorations and investigations, the assessing team made its recommendations for the conservation of Angkor Vat. The entire project was financed by the Ministry of External Affairs under its ITEC Programme and the work was done by the Archaeological Survey of India.

The conservation programme was an endeavour spread over seven years in which various teams of the ASI worked at various seasons from 1986 to 1993. The Archaeological Survey of India had undertaken conservation works in Bamiyan (Afghanistan) and in Angola but neither was comparable in scope to the work in Angkor Vat whose restoration is yet another great achievement of the Archaeological Survey of India.

In a way, it was a great adventure overseas, not unlike the ones undertaken by scholars, artists, merchants and princes who crossed the eastern seas in the early Christian era to trade spices, gems and ideas with their counterparts in Cambodia, Java, Bali and Siam.

Cambodia had barely recovered from the turmoil of the 1970s when the first Indian team, led by late Shri K.P. Gupta, reached Cambodia. Conditions were unsettled and living conditions were austere. Nevertheless, the Archaeologists, Archaeological Chemists, Archaeological Engineers, Surveyors, Draftsmen, Photographers who were part of the teams responded in a spirit of adventure as they set about the stupendous task of restoring Angkor Vat to its pristine glory. Successive teams which went over the period of seven years are as follow :

First Team (1986-87)

1. Shri K.P. Gupta, Superintending Archaeologist
2. Shri Balbir Singh, Retd. ASA Engineer
3. Shri G. Hanumantha Rao, Sr. Conservation Assistant
4. Shri R. C. Sood, Sr. Conservation Assistant
5. Shri S. K. Sharma, Draftsman
6. Shri Mohd. John, Modeller
7. Shri C. J. Sundaram, ASA Chemist
8. Shri Mukhopadhyay, Chemical Assistant
9. Shri A. K. Mathur, ASA Chemist
10. Shri V. P. Sachdeva, Chemical Assistant
11. Shri Sovan Chatterjee, Photographer
12. Dr. Bajrang Lal (from C.G.H.S.)

Second Team (1987-88)

1. Shri K. P. Gupta, SA
2. Shri M. M. Kanade, Dy. SAE
3. Shri R. Veeraraghavan, ASAC
4. Shri L. L. Shah, ASAE
5. Shri D. T. Karamchandani, Sr. CA
6. Shri G. Hanumantha Rao, Sr. CA
7. Shri D. S. Sood, Sr. C.A.
8. Shri M. L. Gupta, Ch. Asstt.
9. Shri P. S. Gupta, Sr. Ch. Asstt.
10. Shri I. Madhava Sarma, Modeller
11. Shri S. K. Jain, Draftsman
12. Shri J. S. Bisht, Modeller
13. Shri B. R. Rajput, Photographer
14. Shri Ram Sahai, Mason

Third Team (1988-89)

1. Shri B. S. Nayal, SA
2. Shri B. P. Thapliyal, ASAC
3. Shri D. I. Kishnani, ASAE
4. Shri S. S. Saini, Sr. CA
5. Shri D. P. Vittal, Sr. CA
6. Shri N. K. Samadhiya, Sr. Ch. Asstt.
7. Shri P. N. Tailor, Ch. Asstt.
8. Shri V. T. Chandi, Sr. Surveyor
9. Shri D. K. Malik, Sr. Modeller,
10. Shri Henry Michael, Photographer
11. Shri Mohd. Qamar, Driver
12. Shri Ram Sahai, Mason

Fourth Team (1989-90)

1. Shri C. L. Suri, SA
2. Shri Chandur Bhatia, Dy. SAE
3. Shri V. P. Khare, ASAC
4. Shri H. L. Raina, ASAE
5. Shri A. C. Chakravarti, Sr. Surveryor
6. Shri S. N. Sharma, Sr. CA
7. Shri C. Rangappa, Sr. CA
8. Shri S. S. Choudhry, Sr. Ch. Asstt.
9. Shri K. K. Swarnkar, Ch. Asstt.
10. Shri V. Lokanathan, CA
11. Shri M.U. Qureshi, Photographer
12. Shri Tahir Malik, Foreman
13. Shri K. G. Rangarajan, Foreman
14. Shri M. N. Vishwanatha, Foreman
15. Shri S. M. Bisnalkar, Mason
16. Shri R. Mangrola, Mason

Fifth Team (1990-91)

1. Dr. B. Narasimhaiah, SA
2. Shri R. C. Mishra, Dy. SAE
3. Shri P. V. Dongre, ASAE
4. Shri H. Mangiraj, ASAC

5. Shri K. Chaturvedi, Sr. Ch. Asstt.
6. Shri Y. P. Thakur, Sr. CA
7. Shri S. Dhandapani, Sr. CA
8. Shri S. Rajendran, Sr. CA
9. Shri S. Raghuraj Kishore, Sr. Draftsman
10. Shri A. K. Jaiswal, Ch. Asstt.
11. Shri P. C. Mittal, CA
12. Shri A. K. Bandopadhyaya, Photographer
13. Shri S. N. Dubey, Foreman
14. Shri M. I. Shaikh, Foreman
15. Shri Bheru Lal, Mason
16. Shri Chanderpal, Mason
17. Shri M. R. Sharma, AO

Sixth Team (1991-92)

1. Dr. B. Narasimhaiah, SA
2. Shri M. M. Raichur, Dy. SAE
3. Shri H. Mangiraj, ASAC
4. Shri R. J. Motawala, Sr. CA
5. Shri J. Ranganath, CA
6. Shri S. Jayakaran, CA
7. Shri S. P. Sringaram, Foreman
8. Shri M. I. Shaikh, Foreman
9. Shri Hazari Lal, Foreman
10. Shri Bheru Lal, Mason
11. Shri Chanderpal, Mason
12. Shri Balbir Singh, Sr. Ch. Asstt.
13. Dr. Ravi Kant, Ch. Asstt.
14. Shri. R. S. Bisht, Ch. Asstt.
15. Shri M. S. R. K. Prasad, Draftsman
16. Shri Rajbir Singh, Photographer

Seventh Team (1992-93)

1. Dr. B. Narasimhaiah, SA
2. Shri M. M Raichur, Dy. SAE
3. Dr. R. P. Singh, ASAC
4. Shri R. J. Motawala, Sr. CA

5. Shri R. S. Bisht, Ch. Asstt.
6. Dr. Ravi Kant, Ch. Asstt.
7. Shri S. Jayakaran, CA
8. Shri J. Ranganath, CA
9. Shri M. S. R. K. Prasad, Draftsman
10. Shri M. I. Shaikh, Foreman
11. Shri S. P. Singaram, Foreman
12. Shri Rajbir Singh, Photographer
13. Shri Chanderpal, Mason
14. Shri Bheru Lal, Mason
15. Shri Nand Lal, Mason

The last team returned in May, 1993 just before the elections began in Cambodia. The expenditure over these seven years was as follows :

1986-87	Rs. 27,21,725
1987-88	Rs. 16,88,287
1988-89	Rs. 45,57,421
1989-90	Rs. 71,55,917
1990-91	Rs. 22,01,977
1991-92	Rs. 52,97,066
1992-93	Rs. 67,98,259

The Indian Embassy at Cambodia, particularly the Indian Ambassador, Shri C. M. Bhandari, has given generous support and encouragement to the teams.

The stupendous effort of the Indian Government and the Archaeological Survey of India has been generally acclaimed by experts of stone conservation. The traditions of the Archaeological Survey of India are such that they abide by the general principles of the Venice Charter where architectural and structural/sculptural intervention is kept to the minimum and where the historicity and artistic authenticity of the structure and sculpture are maintained. However, due to the disuse and neglect of four centuries, measures had to be taken by the Archaeological Survey of India teams to remove cryptogenous substances in the matrix of the stónes. Grouting had to be done to prevent hydroliasis. Sometimes, these measures attracted criticism and were unfortunately mis-interpreted or mis-judged. The Archaeological Survey of India had tried in a spirit of international camaraderie to clarify the preservation and apprehensions voiced in the criticism.

Finally what will remain is the standing and eloquent testimony of the concern of the Government of India and the care of the Archaeological Survey of India to restore a monument which

is a great symbol of Cambodian culture as well as being a part of larger heritage of India and the world.

The last line of Tagore's poem 'Sagarika' says that an Indian traveller came again after vicissitudes of history to see the monuments built in the halcyon days of south-eastern Asian culture. But the traveller has no longer come to trade or conquer. He has come with his veena to share a song with his neighbour.

Dr. B. Narasimhaiah, leader of the last three Archaeological Survey of India teams has recorded meticulously, and with care, this great achievement of him and his colleagues at Angkor Vat.

New Delhi
18 June 1994

Achala Moulik
Director General
Archaeological Survey of India

PREFACE

Angkor Vat temple-complex in Cambodia, symbol of Khmer genius in creating a micro-cosmic universe is world famous, and has rightly been inscribed on the list of World Heritage Monuments by the UNESCO. However, due to innumerable reports appearing in the western media appreciating as well as criticising the principles and methodology adopted by the Archaeological Survey of India in conserving the great heritage of Cambodia. Angkor Vat has been in limelight again particularly since 1986, the year from which the Archaeological Survey of India started the conservation of the monument as part of the bilateral agreement between the Governments of India and Cambodia. Unfortunately, however the work undertaken by the Archaeological Survey of India has been misunderstood rather than appreciated. This is obviously due to lack of effort on the part of the Archaeological Survey of India to counter the criticism by giving wide publicity to the conservation works carried out by the ASI in Angkor Vat. One could perhaps understand this since the Archaeological Survey of India in its long history of more than one hundred and thirty years has never tried to give publicity to the enormous and varied works done for the conservation and preservation of the monumental heritage of India. This has obviously been due to the feeling that the systematic and sustained work being carried out by it will speak for itself. However, it is now necessary, under the present circumstances, to document the works and publish it, not only for silencing the critics, but also as a document for the posterity.

I am greatly indebted to the Ministry of External Affairs and the Secretary, Department of Culture, Ministry of Human Resource Development, on behalf of the ASI and myself, for having full confidence and entrusting the prestigious work of conserving Angkor Vat.

I am thankful to (late) Shri K.P. Gupta, Shri B.S. Nayal and Shri C.L. Suri, who had successfully led the conservation teams from 1986-87 to 1989-90 seasons, and for supplying all relevant information and documents which helped in writing this report. I am also thankful to members of the successive teams whose devotion to duty despite the most difficult and adverse situations made it possible to achieve success in conserving the magnificent temple-complex.

I am beholden to the State of Cambodia, on behalf of successive team leaders and myself, for the full cooperation extended in executing the works, in spite of the extremely difficult times and financial constraints faced by them, and to the staff of the Conservation D' Angkor, who not only helped in all possible manner in the execution of work, but also looked after the comfort of the successive teams, while staying in Siem Reap. My thanks are also due to the hundreds of labourers for their whole-hearted efforts in executing the works.

We could not have achieved the desired result in conserving the Angkor Vat without the active participation of the Indian Embassy at Phnom Penh, the capital of Cambodia. I must mention specially, my gratitudes to Shri C.M. Bhandari, His Excellency the Ambassador to Cambodia, for taking keen interest in the works and for going out of his way to look after the safety and comfort of the teams. I am also grateful to all the staff members of the Embassy.

My grateful thanks to the Publication Section of the Survey for making valuable suggestions and corrections as well as for the trouble taken in bringing out this beautiful publication within the shortest time possible. Thanks are also due to Shri M.S.R.K. Prasad, Draughtsman, and his colleagues for finalising the drawings for publication. I am also thankful to Sarvashri Rajbir Singh, Sovan Chatterji and B.S. Rajput, Photographers of the Directorate, for providing excellent photographs for illustration. Thanks are also due to Shri S. Muralidaran for neatly typing the manuscript.

I would also like to thank M/s Bengal Offset Works who have done a commendable job in bringing out this volume nicely in a short time.

Madras — B. Narasimhaiah

4th May, 1994

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CHAPTER I

INTRODUCTION

The history of Cambodia is well known. However, we shall recapitulate here some of the most important incidents which are relevant to our study. It is believed that in remote past groups of peoples belonging to principal tribes, the Mon and the Khmers of Indian origin, with languages belonging to the same family as those of the Munda and Khasi tribes in India, migrated to Indochina when they felt the pressure of the Aryan waves moving towards their homeland. The Mons settled in Lower Burma and proceeded thence, along the Menam, to the interior or Siam proper, whereas the Khmers settled in Cambodia. Another group, the Chams settled in Annam, known formerly as Champa, using a language belonging to the Austronesian group widespread in the Indian Archipelago or Indonesia. In this background small kingdoms had come to existence in the region, the dominant being Fu-nan with two feudatories, Champa and Chen-la.

Even before the dawn of the Christian era, the Indian merchants were frequenting the region. The interaction was through land route as well as sea. However, for the first time, in the first century AD, a Brahmana named Kaundinya landed in Fu-nan with a political vision. According to legends prevalent in Fu-nan, a *Naga* princess was ruling the country. She used to rob any merchant-ship passing through her territorial waters. Once it so happened that this Brahmana Kaundinya got divine inspiration in his dream, and as directed by the supernatural power, set off on a voyage in a merchant-ship armed with a divine bow. When the ship reached the port of Fu-nan by the force of wind, the *Naga* princess, Soma, came in a boat for plundering it. Kaundinya defeated her by using his divine bow, resulting in surrender of the princess. Kaundinya married Soma, and he became the ruler of Fu-nan. His successors had direct contact with India as well as China through emissaries, and ruled till the end of the fourth century AD.

Once again towards the end of the fourth or the beginning of the fifth century AD, another Kaundinya, a Brahmana and an inhabitant of India came to Fu-nan on the order of a supernatural voice which asked him to go and reign in Fu-nan. The people of Fu-nan cordially welcomed him and elected him as king. He introduced Indian laws, manner and customs, as a result of which the country was thoroughly Hinduised. The rulers of this dynasty occupied the throne of this prosperous kingdom till the middle of the sixth century AD. Rudravarman is the last king to be heard of as the kingdom was conquered by the Chen-la ruler. However, some vestiges of the kingdom of Fu-nan survived till the end of the seventh century AD.

On the other hand the kingdom Chen-la, as feudatory of the Fu-nan quietly consolidated its power in the seventh century AD; in fact, it became powerful enough to assert its supremacy and destroy the suzerain power.

Interestingly, according to a legend the rulers of the kingdom Chen-la are associated with Kambu, the originator of the ruling dynasty. The legend says that the king of Indraprastha, Adityasena (Adityavamsa) was angry with his son and banished him from his kingdom. The banished prince is supposed to have gone to a place named Kokathaloka (the Khmer name of Kambuja nearing the land of the Tholk tree) and became king of that locality after defeating local rulers. One night, while wandering on the sea beach, a *Naga* princess met him. They fell in love with each other and later got married. The *Naga* king, father of the princess, drank the water of the sea and extended the territory of his daughter and son-in-law's kingdom and also got a capital built. According to Baksei Camkron inscription, however, the Kambuja dynasty originated from the union of Kambu Svayambhuva and a nymph named Mera. This Kambu Svayambhuva was an Indian hermit. The kingdom ruled by his progeny, therefore, came to be known as Kambujadesa.

The conquest of the Fu-nan kingdom started by Srutavarman at the beginning of the sixth century AD was completed by Bhavavarman I in the last decades of that century.

However, the golden age of Kambujadesa begins when Jayavarman II was installed as king of Kambuja in AD 802. He is said to have unified the whole kingdom under his rule. It was he who initiated the cult of *Devaraja*. During his time the kingdom included land Chen-la, entire present Laos and Siam (Thailand) with the only exception of Lauvo and Haripunjaya which were Mon kingdoms. It was he who declared independence from Java.

After Jayavarman II as many as 37 rulers came to power one after another till the fall of Angkor in AD 1432. Among these rulers Indravarman I, Yasovarman I, Rajendravarman II, Suryavarman II and Jayavarman VII were the most powerful.

All through the centuries interaction between India and Kambujadesa continued. Not only the merchants were frequenting the kingdom, but also learned Brahmanas and monks went to the kingdom from India to try their fate. Even some of the learned Brahmanas, all through the years, became high priests of kings and married princesses. They played a major role not only in the administration of the kingdom, but also in the spread of Indian culture. For example, Jayavarman II, who initiated the cult of *Devaraja*, invited an Indian Brahmana Hiranyadama to introduce this cult and made him high priest. In addition, some of the teachers and learned men also visited India for further studies. There are innumerable such evidences in the history of Kambujadesa.

Incidentally, it is to be remembered that the *Devaraja* cult was a symbol of the sovereignty of the state under the watchful guidance of the god with whom the king united after death. At a later stage the institution of kingship was made sacrosanct and the king became the manifestation of god. Each king would construct an abode for his *Devaraja* on a *meru*, either natural or manmade. He would consecrate Siva-*linga* as *Devaraja*.

Naturally, as in the case of cultural development of Kambujadesa, Indian influences coming from land route as well as the sea played major role in the development of architecture in the kingdom. The Khmer architects assimilated different types of architectural influences from India and evolved

their own style which ultimately excelled the originals. To cite an example: the *Mahameru* concept was popular in India perhaps before ninth-tenth centuries AD. It may be remembered here that the *Mahameru* is supposed to be the mountain abode of gods amidst milky ocean. This mountain is surrounded by a great wall. This concept was not only assimilated but also beautifully amalgamated with the concept of *Devaraja* cult and evolved by twelfth century AD into a superb architectural form which became an architectural marvel in the whole world in the form of Angkor Vat.

The Khmer architects excelled not only in evolving architectural form but also in the knowledge of engineering, planning and execution. For example, while constructing Angkor Vat under the concept of *Mahameru* on a plain ground, they had to prepare a man-made hillock, by dumping earth. This they planned to prepare in four terraces in ascending order, viz., first, second and third enclosures as well as the *Naga* railing in between the third and fourth enclosures. The central first enclosure which houses the main shrine is at a height of more than twenty seven metres from the original ground level. To prepare these terraces they had to dump large quantity of earth. For this purpose they started digging the moat and the excavated earth was dumped. But, could they afford to wait until the dumped earth consolidated for the construction of the complex? Obviously, that would have taken many decades. They, therefore, devised a brilliant engineering solution by providing foundation of laterite blocks to all the structures which came in the area inside the *Naga*-railing in between the third and the fourth enclosures at the ground level itself, and raise the foundation as walls of laterite blocks as the ground level is raised by dumping the earth, and the boxes formed by the foundation on which structures had to be built with fine sand. When they would reach the level of the structure to be constructed, they would stop dumping the earth and sand and construct the structure. But, where the level had to be raised the process was continued. The area between main shrine and the first enclosure, between second and third enclosures, and third and the railing is therefore filled with dumped earth and the foundation of all the structures have sand. By adopting this unique method not only time was saved, but also strong foundation was provided to all the structures. Owing to this, even though this monument was neglected for many centuries and the jungle had devoured it, foundation has failed nowhere and is in perfect condition.

Further, it is interesting to know that Henri Parmentier in his *Guide to Angkor* reports the following which corroborates the above view. He writes: ".....The pillagers robbed the riches placed under the idol, but made no attempt to seize the repository in the foundations, situated 27 metres below, i.e., at the level of outside courtyards; this repository was found in a daring operation by G. Trouve'. It revealed that the central block was filled with fine sand, an uncompressible base held in by the block of the sandstone and laterite foundations, under the weight of the galleries and the towers." Georges Trouve' was curator at Angkor Conservancy in Siem Reap from 1932 to 1936.

We could perhaps envisage the sequence of construction of the complex. Thus, to begin with, digging of the moat was taken up and side by side providing foundation to all the structures, as stated earlier. Meanwhile, construction was taken up of western gateway of the fourth enclosure which is on the ground level and also represents the fort or wall around the *Meru* mountain.

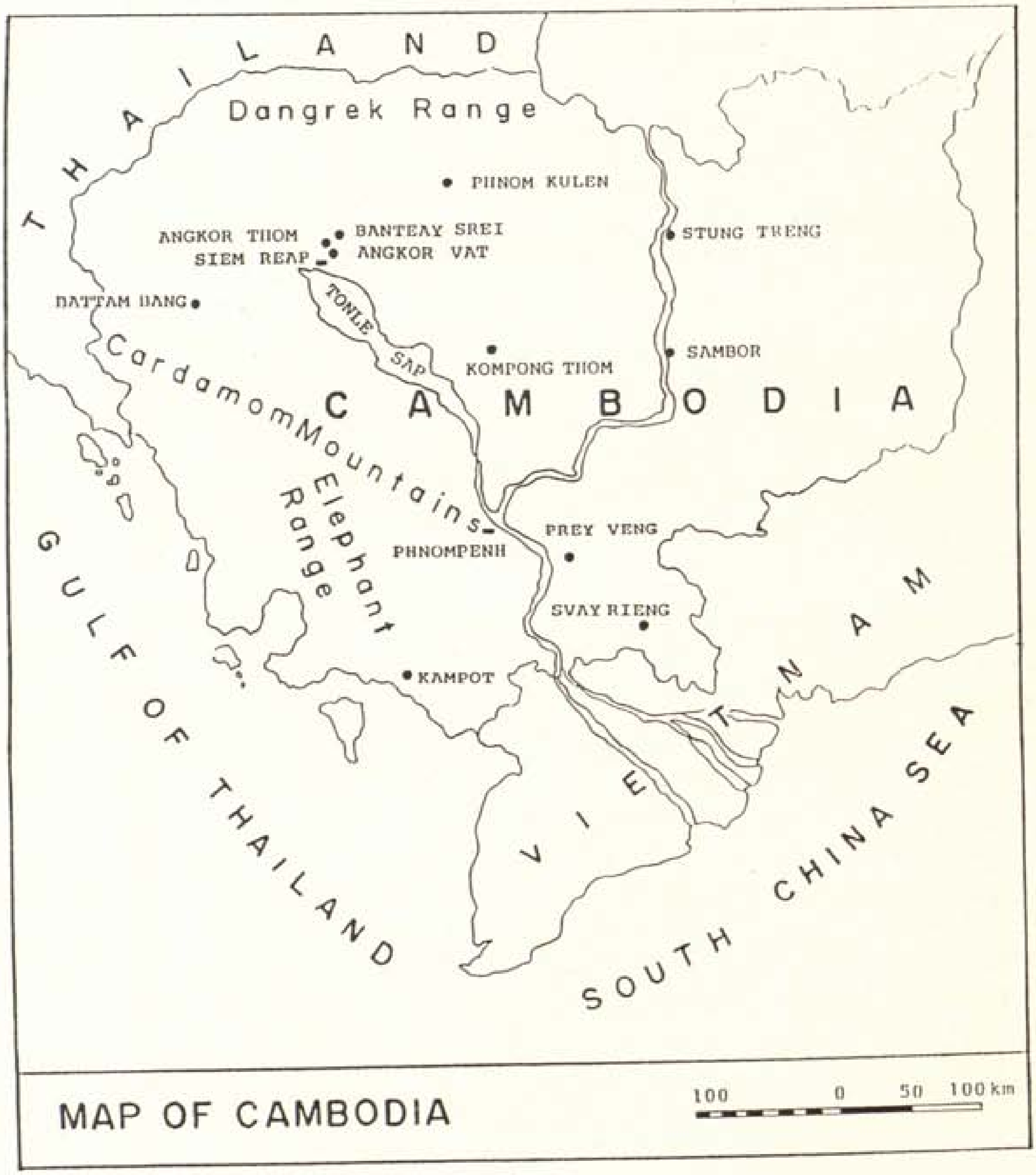

THAILAND
Dangrek Range
PHNOM KULEN
ANGKOR THOM
BANTEAY SREI
SIEM REAP
ANGKOR VAT
STUNG TRENG
BATTAM BANG
TONLE SAP
KOMPONG THOM
SAMBOR
Cardamom Mountains
CAMBODIA
Elephant Range
PHNOMPENH
PREY VENG
SVAY RIENG
KAMPOT
GULF OF THAILAND
VIETNAM
SOUTH CHINA SEA
MAP OF CAMBODIA
100 0 50 100 km

FIG. 1

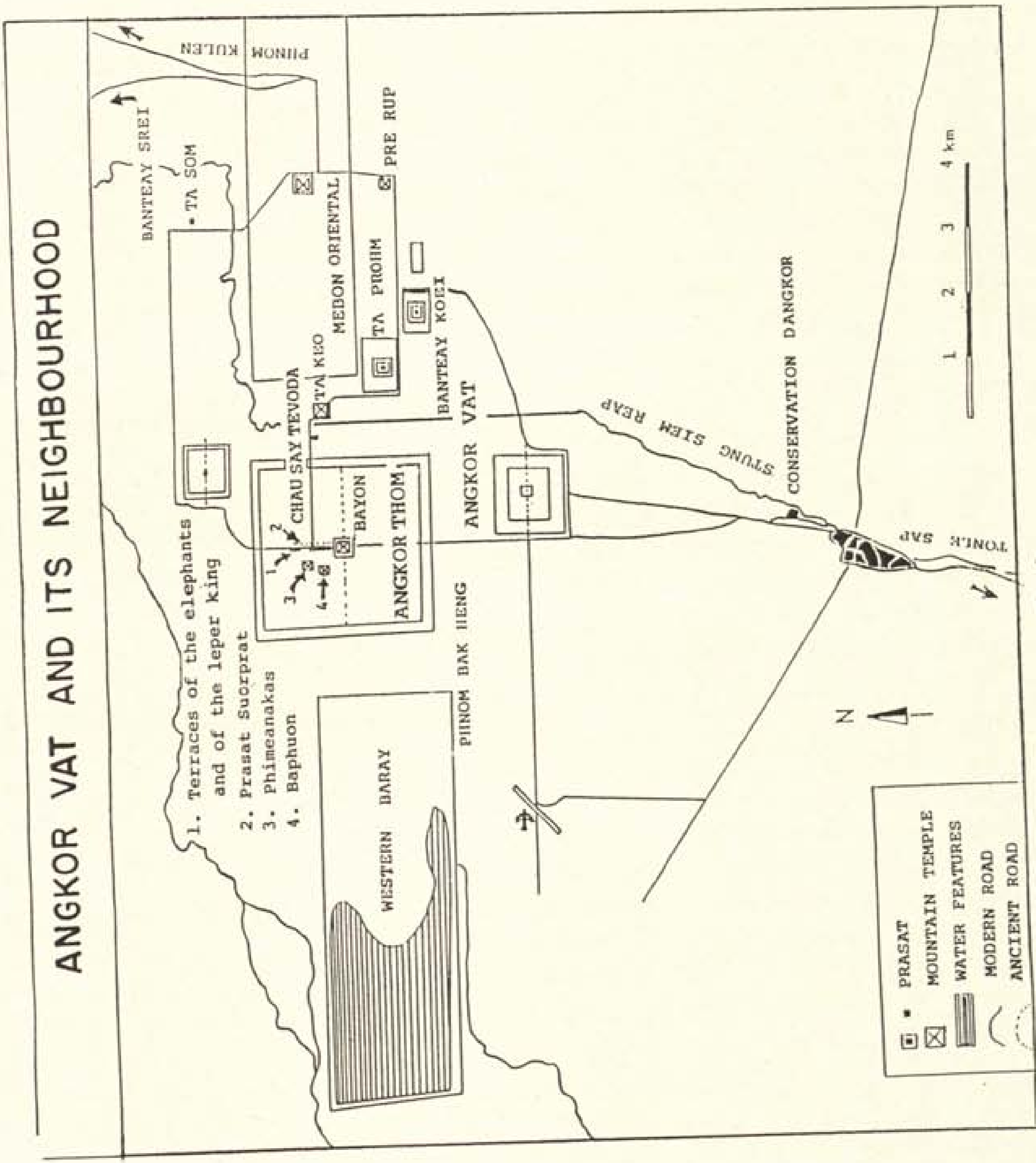

ANGKOR VAT AND ITS NEIGHBOURHOOD
1. Terraces of the elephants
and of the leper king
2. Prasat Suorprat
3. Phimeanakas
4. Baphuon
PHNOM KULEN
BANTEAY SREI
TA SOM
PRE RUP
MEBON ORIENTAL
TA PROHM
TA KEO
CHAU SAY TEVODA
BANTEAY KDEI
BAYON
ANGKOR THOM
ANGKOR VAT
PHNOM BAK HENG
WESTERN BARAY
STUNG SIEM REAP
CONSERVATION DANGKOR
TONLE SAP
N
1
2
3
4 km
PRASAT
MOUNTAIN TEMPLE
WATER FEATURES
MODERN ROAD
ANCIENT ROAD

FIG. 2

Thereafter the main temple and first enclosure which are components of the temple-complex must have been built. Subsequently, the second enclosure and the antechamber were built; finally, the third enclosure might have been built. There are many strong reasons for this presumption. For instance, the third enclosure could not be completed in the lifetime of Suryavarman II who built this temple. Above all, significantly, the northern wing galleries on the western as well as on the eastern sides are longer than the southern wing galleries on two sides, and the northern wing gallery has two more pillars than the southern one. This was done in order to bring all the central entrances on western and eastern sides of all the enclosures and the main shrine into one axis. If the central entrances of the third enclosure had been provided at the centre of the western and eastern sides, the centre line would have gone out of axis in relation to the other entrances. Incidentally, this suggests that the foundation had already been provided which had to be adhered to and construct the enclosure to bring symmetry.

Be that as it may, conservation and preservation of monument of such a magnitude as that of Angkor Vat is a herculean task.

The Angkor Vat, built by Suryavarman II (AD 1112-1152), is dedicated to Vishnu, with whom he was identified as *Devaraja*. With its soaring towers and expansive bas-reliefs, the Angkar Vat is perhaps one of the most inspired and spectacular monuments conceived by the human mind. It is standing testimony to the knowledge and skill of the Khmer architects in the form of construction of a monument of vast scale and magnitude not only in space but also in verticality. No wonder, it is estimated that tens of thousands of persons worked for almost forty years for building the temple-complex (figs. 1-3), occupying nearly 500 acres of land, using about 35 million cubic feet of blocks of stone.

The temple-complex (pls. I-II) is enclosed by a 200 m wide moat with stepped embankment made of huge moulded sandstone blocks, representing the 'Milky Ocean'. On the western side, as the temple faces west, this ocean-like moat is crossed through a 11·6 m wide causeway. This causeway is paved with sandstone blocks and has *Naga* railing having at regular intervals beautifully carved five- or seven-hooded heads of *Nagas*. The causeway leads to the main gateway of the fourth enclosure. The fourth enclosure, built of laterite blocks, representing great wall around the *Mahameru*, covers an area of 1025 x 800 m. The other three sides of the enclosure are also provided with gateways built of sandstone blocks, but the western one is the most imposing running to a length of 220 metres.

The gallery with verandah of the main gateway has five entrances, the central one being the largest. The central and the two flanking entrances are crowned with *gopuras* (towers), but the central one is the tallest. The other two entrances at extreme ends of the gateway are known as elephant gates, since the porches do not have any flight of steps. All the entrances are provided with central pavilion, cruciform in plan, attached to a higher porch and a lower porch. In addition, all the porches and pavilions at the entrance are decorated with beautifully carved *toranas* at the top.

This arrangement is repeated in all the entrances in the complex without any exception. The *gopuras* (towers) and the entire eastern and western façades of this gateway are beautifully embellished with intricately carved designs in low relief and bold bas-reliefs of *apsaras*. In fact, in the entire complex, the carvings on this gateway are of the highest standard.

After the western entrance, the temple is approached by a long 8 m wide paved causeway running to a length of 360 m. The causeway is flanked by *Naga* balustrades with beautiful *Naga* heads at regular intervals. The two libraries, one each on either side of the causeway, in the vast stretch of open space, and two square tanks in front to the east of them, add beauty to the complex. In fact, a pair of such libraries, of course without tanks, is provided in between the second and the third as well as the first and second enclosures. These libraries must have been miniature shrines for *parivara devatas* in the original scheme of the temple-complex, but might have been converted into libraries when the temple was rededicated to the Buddha, since Buddhism has no place for *parivara devatas*.

Be that as it may, the causeway directly leads from fourth enclosure to a majestic cruciform platform nearly 3 m in height, framed by *Naga* balustrade, attached to the main central entrance of third enclosure on the east. On other three sides, it is approached by flights of steps. The majestic look of this platform is amplified by the huge figures of squatting lions guarding the flights of steps. This platform called as esplanade, must have been used as *ranga-mancha* anciently, even to day the platform is being used on special occasions for the performance of traditional dance and music.

In between the third and the fourth enclosures, a *Naga* railing has been provided. This stands to a height of nearly 3 m from the ground level on a strong and massive plinth.

The third enclosure stands majestically on a 4·5 m high plinth. The western and eastern galleries of the third enclosure, as in the case of fourth enclosure, are provided with five entrances with pavilions and porches, embellished with decorative *toranas* at different heights, which are a treat to the eye. But there are some differences in the entrances of third enclosure in having stepped entrance porches on two exterior sides of the corner pavilions and in not having pyramidal *gopuras* (towers) on any of the entrances. The northern and southern sides are provided with only three entrances. The third enclosure measures 250 m (east-west) by 187 m (north-south), while the bas-relief panels on the rear wall of the galleries run to nearly 700 m, perhaps one of the longest running panels in the world. The eight panels represent such varied subjects like the Kurukshetra war between the Kauravas and the Pandavas, expedition of Suryavarman II, depiction of *svarga* and *naraka*, *samudra-manthana* by gods and demons, Vishnu waging war on demons, Krishna waging war on Banasura, gods waging war on the demon Kalanemi, and the battle between Rama and Ravana. Another great work of art are the eight walls of cruciform entrance pavilions at southwest as well as northwest corners which have been used to carve stories from the *Ramayana*, the *Mahabharata*, etc.

Between the second and the third enclosures is a quadrangle divided into four parts by two cross galleries. Each part has a tank-like square structure with internally projecting platform on one side. This whole area can be identified as *Vedasala*, and the four tank-like structures are not tanks, but,

in fact, they are sacred areas used for religious rituals, and the four parts represent the four *Vedas*. However, further study is necessary to confirm this.

The second enclosure gains a height of 7 m by its plinth. Except for the beautifully carved *toranas* and the pavilions at four corners crowned by pyramidal *gopuras* (towers), it is very simple. The area between this enclosure and the first one is well paved.

The first enclosure suddenly gains a height of 13 m from the second enclosure and nearly 27 m from the ground level, by a massive plinth. The four corner entrance pavilions, as in the case of the second enclosure, are provided with pyramidal *gopuras* (towers). At the centre of the enclosure the main shrine stands majestically. It has four entrances on four cardinal directions. It is *sarvatobhadra* in conception. The *vimana* of the shrine is 36 m in height from the floor of the first enclosure and 63 m from the ground level. The four entrances are connected with the galleries of the first enclosure by axial galleries. The area between the enclosure and the shrine is paved with sandstone blocks. The carvings on the *toranas* and the walls of the central shrine and the *sikhara* are of high standard. As in the case of other *toranas* on all other enclosures, the incidents from the *Ramayana*, the *Mahabharata*, mythological stories, *Puranas*, etc., are beautifully depicted.


Deservedly, this magnificent monument, a true representative of 'Cosmic Universe' on earth, has been inscribed in the list of World Heritage monuments, by the UNESCO.

However, the Angkor Vat lost its importance in the history of Kambujadesa, since the capital was shifted to Phnom Penh after the final defeat at the hands of Siam (Thailand) in AD 1431. Since then Kambujadesa also lost its leading role in the region. After sixteenth century the grandest of monuments, Angkor Vat, fell into oblivion, and the forest started approaching it and ultimately engulfed it, and erased its memory.

Fortunately, this forgotten wonder was rediscovered from the depths of the jungle by Henri Mouhot in the late nineteenth century AD. Once again it became focal point for research and critical appraisal by scholars from many parts of the world.

France, under whose control was the state of Cambodia, with a view of organizing studies on ancient art and architecture of Kambujadesa, established Ecole Francaise D' Extreme Orient in 1878. Later, in 1907, the office of the Keeper of Angkor was organized in the precincts of the Angkor Thom. The keeper was responsible for executing certain preliminary measures as a first step which involved clearing the area of the monument, checking further deterioration of monuments, and not allowing vegetation growth in the monuments, etc., with the basic aim of preserving whatever is existing and containing further damage to the monuments. However, stress was more on research than conservation. This state of affairs continued upto 1930.

From 1930 onwards, partial restoration of the monuments was attempted. For example, Henry Marchal analysed Bante Srei in 1932. Subsequently, similar work was taken up in many monuments in Cambodia.



MSRK PRASAD (ASI)

Fig 3

In 1960 however conservation work and its methods were completely reorganized. A vast agglomeration of workshops was built in the complex between Siem Reap and Angkor Vat, called Conservation D' Angkor. Simultaneously, forward workshops were also built in Baphoun and Angkor Vat. This can be recognized as second stage of conservation in which all the causes of deterioration of the monument were scientifically analysed, and the problems suitably solved and the works executed systematically within the parameter of principles and methods of conservation, and also real conservation works like restoration, dismantling and reconstruction of the part of the monument, wherever necessary, strengthening of foundation with a view to strengthening the structure, etc., are carried out. However, before the Conservation D' Angkor could complete the some serious work of conservation at Angkor Vat, the French had to leave the country in 1972 due to worsening political situation. Thus, the first phase of conservation came to an end in which the first stage of conservation had been executed and the temple was ready for second and third stages of conservation.

There is also a lesser known phase of conservation at Angkor Vat. From 1972 to 1986, the Cambodian authorities at Conservation D' Angkor did some conservation work. Unfortunately, there is no record of the works done and, therefore, sometime they are either attributed to French or Indian efforts. Obviously, the efforts of the Cambodian authorities were inexperienced and inadequate and was also not of sustained and continuous nature due to political unrest. Owing to this, once again the complex fell under negligence and the destructive agencies became active.

Indian appearance on the scene of conservation at Angkor Vat is the third phase. In April, 1980 Prince Norodom Sihanouk appealed to the world community to come forward to save the Angkor Vat. The Government of India responded favourably and sent a team of three persons in November-December 1980 to assess the damage to the Angkor Vat and neighbouring monuments and to prepare a rough estimate for conserving them. The team submitted its report and estimate. The Government of India, through its permanent representative, approached the member countries of the UNESCO and its head, and discussed the report with a view to harnessing the co-operation of member countries for the conservation of Angkor Vat. However, the efforts failed due to political reasons.

The permanent representative, explaining the situation at UNESCO, appealed to the then Prime Minister, Smt. Indira Gandhi to do something to save Angkor Vat. Smt. Indira Gandhi responded by sending another team of nine experts to submit a detailed project report on conservation of Angkor Vat including the total expenditure involved. The detailed report was submitted by the team in 1982. The report was accepted by the Government of India, and the Prime Minister showed her keenness to take up the prestigious work at an early date. In spite of the readiness of the Government of India to start the works immediately, the signing of the final bilateral agreement continued to hang on till 1986. Once the bilateral agreement was signed, the conservation work at Angkor Vat, an architectural marvel, was taken up by the Archaeological Survey of India from November, 1986. The Archaeological Survey of India since then has worked for seven seasons, in close co-operation with the Government of Cambodia.

A detailed report on the work carried out by the Archaeological Survey of India in saving the Angkor Vat complex, which is unique for its bold conception and creative genius, for preserving the monument for posterity is described in the following chapters. However, a few words about the method and techniques to be adopted by the conservation teams who wish to conserve the monuments in future in Cambodia would not be out of context. The techniques and methods we use should not only be prefect and educative in nature but should also create confidence among the local people. We shall be failing in our duty to save not only Cambodian cultural heritage but also of the world, if we do not inculcate confidence in the local people themselves to take up the conservation works in future. Because, it is their heritage and ultimately they have to preserve these. Therefore, we should use only such methods, techniques and above all equipment which could be used by the people at large of the country confidently and with ease. This would help the country in a long way to save their own heritage for posterity.

CHAPTER II

PRINCIPLES AND METHODS

It would not be out of context to remember here that the Archaeological Survey of India is preserving more than 5,000 ancient monuments and sites dating back from the middle of the third millennium BC to even modern British Colonial structures of eighteenth-nineteenth centuries AD and variety of monuments in regions having different climatic conditions, built in a variety of materials one can think of. The organization's history itself is no doubt a romantic one.

Though the birth of the Archaeological Survey of India could be traced back to the 1860s, the true beginning of the archaeological pursuits started because of Dr. Samuel Johnson who conceived the supreme need for the systematic investigations into India's past through its remains, and which he conveyed passionately to the then Governor General Warren Hastings in 1774. In decades to come, due to the impetus given by Warren Hastings to research, the scholarly world was flooded with valuable reports from scholars and amateurs alike on the archaeological wealth of India, through Asiatic Society and other such voluntary platforms all over India. As a natural sequence of things to come, the archaeological wealth brought to light had to be preserved for the posterity. Therefore, in 1860, Lord Canning, the first Viceroy of India established the Archaeological Department of North India, significantly not a British School for Indian Studies, for the preservation of ancient monuments in the region. Alexander Cunningham was appointed as the first Archaeological Surveyor of India.

Then in 1866 the post of the Archaeological Surveyor was abolished by Lord Lawrence. But, fortunately, due to sustained and persistent agitation by the eminent scholars like James Furgusson and others, Lord Mayo, the then Viceroy, created the post of the Director General of the Archaeological Survey of India in 1870. The post was obviously offered to Alexander Cunningham.

However, the Archaeological Survey of India had to wait for a dramatic and significant change in its history till the arrival of John Marshall as its Director General in 1902. He was only 26 years of age and had already worked in Greece, South Turkey and Crete. It is in his brilliant tenure that the Ancient Monuments Preservation Act was passed in 1904. And, once again it was in his enlightened period *Conservation Manual* was published in 1923. His enlightened principles and meticulous methods prescribed to be adopted in preserving ancient monuments are still being followed by the Archaeological Survey of India with religious faith in its works.

After John Marshall (1928), many important personalities held the post of the Director General. But most significant is that two Indians occupied this supreme and coveted position before India attained Independence in 1947. And, by the time the British left India, the Archaeological Survey of India had become completely Indianized.

Be that as it may, John Marshall in his *Manual* has given well defined principles and methods. Even the smallest of the small problem of conservation has not escaped from his purview. The principles and methods which are being followed by the Archaeological Survey of India are not only relevant in Indian context, but are most relevant elsewhere as well.

For example Marshall says, ".......officers charged with the execution of conservation work should never forget that the reparation of any remnant of ancient architecture, however humble, is a work to be entered upon with totally different feelings from a new work or from the repairs of a modern building. Although there are many ancient buildings whose state of disrepair suggests at first sight a renewal, it should never be forgotten that their *historical value is gone when their authenticity is destroyed,* and that our first duty is not to renew them but to preserve them. When, therefore, repairs are carried out, no effort should be spared to save as many parts of the original as possible, since it is to the authenticity of the old parts that practically all the interest attaching to the new will owe itself. Broken or half decayed original work is of infinitely more value than the smartest and most perfect new work" (*Conservation Manual*: pp. 9-10; para 25).

It is needless to say that this principle is even more relevant in the conservation work at Angkor Vat. It should be remembered that historical value and authenticity is not only for the superstructure or for a part of the monument, it is for the whole of the monument including the foundation. It is saddening to know that any and every malady in the monument is attributed to failure of foundation. Restrain should be used while talking about foundation as it is an integral part of the monument reflecting the knowledge of engineering of the people and the age to which the monument belongs. Foundation failure means that the people of that age had no knowledge of the type of foundation to be provided and due to this ignorance the foundation failed. Changing of original foundation is nothing but our arrogance. However, there may be disturbance in foundation which may be purely due to interference of natural causes like vegetation growth, stagnation of water, etc. This does not mean that the foundation was faulty. Another aspect is that interfering with foundation may require total dismantling of the structure. While dismantling and reconstructing, the architecural members may be damaged, and, most importantly, while reconstructing errors may creep in which may turn out to be of very serious nature. This had happened in the reconstruction of Samudramanthan Gallery (Southern Gallery on eastern side of the Third Enclosure), which cannot be rectified until the whole gallery is dismantled once again and reconstructed. (This aspect is dealt in detail under the chapter on structural conservation). Therefore, dismantling and reconstruction of any structure in the conservation work, as in India, should be the last resort. How rightly Marshall has said that broken and half-decayed original work is of infinitely more value than the smartest and the most perfect work.

In this context the person who ventures to dismantle and reconstruct a structure should always remember that not only perfect photo and graphic documentation is necessary, but also permanent 'bench marks' indicating different levels from many angles is a must. The 'bench marks' should be

on the site at several places for ready reference while reconstructing, and the 'bench-marks' should not be dismantled until the completion of the work. If this had been taken care of, possible error would not have occurred in the reconstruction of Samudramanthan Gallery as well as the railing between the third and fourth enclosures.

Another aspect to be remembered is that the person who is entrusted with such work should not be over-ambitious and dismantle large portions of a monument which cannot be reconstructed within a short period. The best example is Bhapuon in Angkor Thom which cannot be reconstructed in future. Large parts of the monument were dismantled by the French, but were not reconstructed.

While talking about foundation, it would not be out of context to say that whether the original foundation which was taking the load of the structure for more than eight centuries is time-tested or the one which we are going to lay in the twentieth century. One can see that huge wall-like RCC structures, provided with the fond hope of strengthening the monument, in Bhapuon are crumbling, but the dilapidated original parts are still standing.

Another point to be remembered before jumping into conclusion about foundation failure is that some problems may seem at the outset as due to sinking of foundation, but careful study from all angles may turn out that it is, in fact, due to inherent error in the original construction. This is very well illustrated in the verandahs of galleries of third enclosure. Here, even the error is of historical value. Therefore, while conserving, the original error should not be obliterated, but solution should be such that the problem does not recur. This is what the Archaeological Survey of India has done in conserving all the verandahs of the third enclosure.

It should also be remembered that vegetation growth can dislodge the architectural members, even weighing several tonnes, horizontally. It would be especially easy for vegetational growth to dislodge the masonry where very smoothly dressed stone members are used in the construction, as they slide very easily with little effort. Therefore, one should not come to the conclusion that foundation has failed when one encounters a monument with severely dislodged portions.

About repairs to friezes and images, Marshall states that "....... the spaces occupied by images in friezes and string courses should, in repaired portions, be left blank. Broken images should not be mended with new limbs or other parts, but old portions may be pieced together, as far as practicable" (*Conservation Manual* : p.26; para 83).

Obviously the images and friezes are individual's concept, imagination and skill of the person who has carved, and also particularly of that period. Suppose a broken image of twelfth century AD is mended with new limbs or other parts then who should be credited with authorship, and what is the date of the image? Now, in Angkor Thom, in the Elephant Platform, the broken and damaged elephants in the elephant frieze have been provided with new limbs and parts under the able guidance of the French archaeologists, without thinking of historical value and authenticity of the frieze. However, in Angkor Vat though there was plenty of opportunity to mend the images and friezes, the Indian Conservation Teams stuck to the principle laid by Marshall, and the damaged images were consolidated and preserved.

Marshall (*Conservation Manual*: p.26; para 85) insists that "Any carved stones or bricks or any pieces of tilework that are found lying in the debris on old sites, should be restored, if possible, to their former positions, provided always that no doubt exists as to what those portions were". But, the Archaeological Survey of India has gone further, and now, even simple original architectural members lying on the site are being restored to their original positions. All possible efforts should be made to achieve this. The best example of this can be seen in the efforts of the Archaeological Survey of India in restoring the architectural members of the libraries, which are lying on the site, to their origina positions. The Archaeological Survey of India has succeeded in restoring hundreds of architectural members of their original position in the whole of Angkor Vat temple complex.

Regarding dismantling and rebuilding certain portions of a monument, Marshall (*Conservation Manual*: pp. 60-61; para 221) has this to say: "When the core of a wall is found to be either full of earth or disintegrated or dry built, it may be necessary to remove some of the face stones in order to clean out the dirt..... before putting the work in hand each stone should be numbered, and a diagram or photo prepared, showing the numbering, in order that the stones may be replaced in their original positions. After the removal of the face stones the core of the wall should be thoroughly raked or washed out and loose mortar or dirt extracted. The backs and joints of the stones should then be cleaned and they should be replaced in their correct positions, rebedded in cement or lime mortar, and pointed up.............."

This is exactly what the Archeological Survey of India has done in conserving all the dislodged portions of the complex. All the stepped entrances and even south-western corner entrance pavilion were conserved with utmost care. Furthermore, only the portions which were absolutely necessary to be dismantled were removed and reset to achieve the expected result.

Grouting is one of the most effective conservation measures to make a structure strong. Marshall had recognised this and instructed (*Conservation Manual*: p.30; para 100-102) : "Narrow cracks in walls may be filled with lime or cement grout. Wider fissures may be filled with lime or cement concrete ..... Unless there are special reasons to the contrary, the grout or concrete should be recessed from 1/4" to 1/2" from the face of the wall , according to the width of the crack and the relative coarseness of the filling material. The filling material will be coloured and finished to match the adjoining surfaces.........Before filling, cracks or fissures whether in roofs or walls, should be well cleaned and watered, and the filling material should be worked deep into the cracks, and not merely plastered on the outside".

Regarding related conservation method like pointing, he *(Conservation Manual*: pp.56-57; para 203, 205-207) says: "The joints of the walls should be deeply raked out, to get rid of all loose dirt or old mortar, and to destroy the roots of weeds, grasses, or jungle which may be growing in them ...... They (joints) should then be washed out thoroughly with clean water .... Where the raking out exceeds 3 inches in depth, the joints are, before pointing, to be tamped with cement mortar well pressed home with special tools. The cement mortar is to be kept back a minimum of 2 inches from

the face of the wall .... Only so much of the masonry is to be tamped at one time as will permit of the pointing being done while the cement is still green ..... Each joint should be finished off at once, and successive layers of the mortar should be avoided".

Grouting and pointing are time-tested measures of conservation which the Archaeological Survey of India is using in almost all the ancient monuments, especially in the monuments in the tropical climatic regions. Unfortunately, in the Angkor Vat temple complex, the French who conserved it before 1970 thought of a novel idea of filling up the gaps and joints with fine clay and then pointing in cement mortar. Obviously, this method of conservation has proved to be disastrous to the monument as it is in the tropical condition. The pointing cracked within a few years and the vegetation grew vigorously as it got fertile background. Therefore, the Archaeological Survey of India had to struggle hard to make the structures in the complex watertight. It is extremely important to remember that the person who is entrusted with conservation of important monuments should not conduct any experiments. He should always use the time-tested methods. If experimentation in some new methods is necessary, it should be done in a monument of insignificance, and only after ascertaining that the experiment is a success, it should be used in other important monuments.

Marshall has rightly observed about vegetational growth over the monuments which may play havoc. He says: "In removing weeds, trees or shrubs, etc., from walls it is essential that the roots should be completely destroyed, and during the process of raking out, any tendrils found in the joints should be followed up and removed. The growth of vegetation in the joints of ancient brick or stone buildings is one of the principal factors in causing their ruin, and the only sure way of dealing with this evil is constantly to eradicate the plants before they become fully rooted ...... Joints which have to be raked out in order to destroy the vegetation should, after the earth, etc., has been removed, be immediately repointed (*Conservation Manual* : pp. 67-68; para 253-4)"

The ancient monuments in Cambodia including the famous Angkor Vat are the best examples which show what a disastrous role vegetational growth could play over the monuments. Vegetation growth can tear the monument to pieces. Therefore, especially in the tropical climatic region no vegetation should be allowed to grow over and in the immediate vicinity of a monument. The Archaeological Survey of India, obviously, has paid more attention to this aspect and has done whatever it could to remove vegetation growth over the structures in the Angkor Vat complex. In spite of all odds, all the five towers including the central one in the first enclosure were also thoroughly watertightened and all the joint and crevices have been sealed. However, it should be remembered that to keep away any monument from this menace maintenance is a necessity. Otherwise, once again this evil may find its way back and grow over the monument.

Drainage system is also one of the main problems which has to be taken care of in safeguarding the monument from decay. Marshall insists (*Conservation Manual*: p.32; para 109): "Proper provision is to be made for drainage, especially for taking off flood water after heavy rain. Water

must not be allowed to stand about in pools or ditches near an ancient monument. The walls of many monuments are none too secure, and scouring of earth away from their foundations may cause much damage. Drains should be made as inconspicuous as possible......."

No doubt providing drainage system to a monument is as important as any other measure of conservation. But, before providing an drainage system, one should bring the surrounding to its original level, and also try to recondition the original drainage. Only after revitalizing the original drainage system, if one feels it is inadequate, then only additional system should be provided. But care should be taken not to provide such system which would take away all the rain water and dehydrate the monument. Because dehydration of a monument will have as serious effect as stagnation of water around the monument. Therefore, care should be taken to see that some percentage of rain water percolates into the ground around the monument.

Needless to emphasise that Marshall's words have been extensively quoted above only with a view to make it clear that the Archaeological Survey of India guided by well-laid principles and time-tested methods has executed conservation work with the dedication of a doctor to a patient, and also with involved feelings. These principles have become a tradition with the Archeological Survey of India, and traditions die hard. The Archaeological Survey of India has not given any place for experimentation in a magnificent monument like Angkor Vat.

CHAPTER III

STRUCTURAL CONSERVATION

The conservation of ancient monument is a never ending work, especially in a monument of such magnitude as Angkor Vat it is still more so. It is still harder when the work is bound by time limit. However, the Archaeological Survey of India, with a view of consolidating the monument from further decay, restoring the portions which had been either dismantled by the previous agencies or had collapsed, etc., carried out the conservation works, under the framework of well established and time-tested principles and methods. The following are the works executed from 1986-87 to 1992-93 seasons.

1. STEPPED EMBANKMENT OF MOAT (pls. III-V)

It may be recalled that the moat had stepped embankment with landing on either side and with the steps made up of moulded sandstone blocks. The embankment is in dilapidated condition. In fact, at many places the traces of it were obliterated.

The French Conservation Team had reconstructed certain portions of the eastern embankment from the causeway to the point coinciding with the end of the southern wing of the Western Gateway. Therefore it was decided to reconstruct the eastern embankment from the causeway to the point coinciding with the end of the northern wing of the Western Gateway, from the point of view of beauty and symmetry as well as to stop erosion of soil from the area in front of the Gateway.

Careful observation at several areas of the dilapidated embankment indicated that the structure had collapsed not due to failure of foundation, but owing to combined action of heavy vegetational growth and rain water. In the first instance, due to long span of negligence, small bushes had started growing in between the joints of the landing and the steps. Then the rain water started percolating into the core of the structure. As decades went by, small trees replaced the bushes and the roots dislodged the architectural members. Rain water gushed into the voids created by dislodging of the members and eroded the core as well as soil below it. Subsequent growth of tall trees along with storm water drain did the rest.

The original method of construction is very interesting. In the first instance, the embankment was cut into steps until hard soil was hit. Over these steps neatly dressed laterite blocks were laid to required height and shape. Then the prepared core was encased with moulded blocks of sandstone veneering. However, the lowermost seven steps are of laterite blocks and the upper six steps and landing are of sandstone. The embankment measures 2·75 m in height and 5·50 m in width.

The conservation method adopted is as follows:

In the first instance, all the architectural members were documented and numbered. Then the original level of each step and landing was identified and marked. Thereafter, the dislodged members

were dismantled and stacked properly. After dismantling, original cuttings in a stepped manner were cleared of all the debris and loose soil until hard stratum was struck. Over this hard stratum a concrete bed was provided over which the core of neatly dressed laterite blocks was laid as per the original and then the steps and landing were reconstructed using dismantled architectural members as per the original. Thus the embankment was reconstructed to a length of more than 120 m . Utmost care was taken not to leave any gap between the blocks. It is needless to say that hundreds of laterite blocks had to be dressed to required shape before using them as core material, so that there would not be any slightest gap in the core. The gap between the steps and the cuttings was also filled with cement concrete so that entire stretch of structure becomes one unit and would not be easy to dislodge. In addition, a drain all along the embankment and another between embankment and the outlet in the fourth enclosure wall were provided as a safety measure to the structure from the storm water. Altogether one thousand three hundred and eighty-two (1382) architectural members were dismantled and reset, while executing this work.

2. FOURTH ENCLOSURE ON WESTERN SIDE (MAIN GATEWAY)

(a) Northern Elephant Gateway

The plinth of this gateway was in a precarious condition due to dislodgement of architectural members. The dislodgement was due to heavy growth of vegetation and percolation of water. The roots of the trees had not only dislodged the members of the veneering but had penetrated deep into the core as well as foundation and had disturbed them. The dislodgement and penetration of roots were so severe in some areas like northern side, north-east corner and north-west corner, that there was no alternative but to dismantle and reconstruct the affected portions. After careful documentation of the areas, the architectural members were dismantled and stacked properly. The roots of vegetation was thoroughly removed from the core and the foundation, and then they were strengthened by filling in the cavities with liquid cement mortar. Thereafter, the dismantled portions were reconstructed as per the original by using dismantled architectural members.

In addition, all the successive *toranas* which were in dangerous condition due to the architectural members going out of plumb, were also conserved by carefully resetting the members in their original position (pl. VI). In some cases where the members had been dislodged severely had to be dismantled, and after strengthening the core the dismantled portions were reset in their original positions.

In the process of conservation. altogether one hundred and thirty-five (135) architectural members were dismantled and reset.

(b) Southern Elephant Gateway

As in the case of the above mentioned gateway, the plinth of this structure was also in a dilapidated condition at many places like the western and the southern sides as well as south-west corner, due to heavy vegetational growth. The dislodged architectural members were dismantled and after removing the deeply penetrated roots and consolidating the core as well as foundation, the dismantled architectural members were reset in their original position (pl. VII).

Altogether thirty-six (36) architectural members were dismantled and reset while conserving the affected areas.

(c) Stepped Entrance on West to Northern and Southern Galleries

The steps of the two entrances had been dislodged and the joints in between the masonry had widened due to vegetational growth. Therefore, all the steps were dismantled after proper documentation. Then, the core was consolidated by grouting and pointing. Over the consolidated core the steps were reconstructed as per the original. Altogether twenty (20) stone members were dismantled and reset.

(d) Exterior and interior of Galleries

A lintel of the verandah with semi-vaulted roof between central and north of central entrances had broken into three pieces. The earlier conservators had supported this lintel with RCC props. The broken lintel was made free by dismantling some of the members of the semi-vaulted roof. Then the three pieces were mended together by using epoxy resin. The mended lintel was strengthened by providing concealed reinforced concrete all along it. After fixing the lintel in its position properly, the dismantled members of the semi-vaulted roof were reset. Finally the RCC supports were removed (pl. VIII).

Likewise, twenty-six (26) broken lintel and brackets all along the verandah of western gateway were mended and strengthened by providing either concealed steel dowels or by reinforcing with cement concrete, as the case may be.

The flooring of the verandah with semi-vaulted roof between northern elephant gateway and the entrance north of central entrance which was undulating was reconditioned by dismantling the floor-slabs and relaying them properly after consolidating the bed below the floor level. However, in other areas of the galleries, verandahs and entrance pavilions, where the flooring was in good condition,the joints in between the floor-slabs were grouted and pointed with liquid cement mortar, wherever necessary, so that the rain water does not percolate into the bed of the floor and disturb it.

The joints in the exterior and interior sides of the walls of the gateway as a whole were grouted with liquid cement mortar and pointed wherever necessary. Likewise, the vaulted and semi-vaulted roofs of the gateway including elephant gateways, were also watertightened from interior and exterior. The cavities above the doorway of the eastern entrance porch of central entrance were filled with suitably cut sandstone pieces and the joints pointed in cement mortar of matching colour.

Some of the damaged *apsara* bas-reliefs were also mended by using sandstone carved into exact shape and size.

The loosened architectural members of the central tower (*gopura)* were fixed in their proper position by providing concealed steel dowels. All the crevices in the *gopura* were grouted with liquid cement mortar and the joints were pointed with cement mortar of matching colour. Likewise, two

towers *(gopuras)* north and south of central tower *(gopura)* were also conserved. In addition, the openings at the top of *gopuras* formed due to the missing architectural members, were sealed by providing RCC slabs.

A foundation protection apron in cement concrete was provided between northern elephant gateway and central entrance on the east and from the entrance north of central one to the northern elephant gateway on the west.

3. SOUTHERN AND NORTHERN LIBRARIES BETWEEN THIRD AND FOURTH ENCLOSURES

The conservation of the southern and northern libraries between third and fourth enclosures was of altogether different nature. It may be recalled here that certain portions of these structures had been dismantled in the distant past for unknown reasons and the members had been stacked at a distance. Unfortunately, the architectural members were not numbered. Further, there was no indication about their original position in the structures. Besides, when we started identifying the members which could be reset in their original position, it was noticed that some of the members were missing only due to human vandalism. For example, the stones of the upper courses of certain portions were available, whereas the members of the lower courses were missing. But we decided to put back the available original architectural members in their place in the structures with a view: (a) to avoid further decay of the members lying in the open on the ground, and (b) to provide missing roof portions over the structures where rain water was pouring into them. This difficult situation was overcome by providing laterite blocks for the missing courses upto the bottom level of the upper course for which the original stones were available. The laterite blocks used in the structures were plastered in suitable colour in view of aesthetic value. Using this method many parts of the two libraries could be restored.

(a) Southern Library

PORCHES—The plinth portion of all the four stepped entrance porches on four sides of this structure were in a dilapidated condition due to dislodgement of architectural members owing to heavy growth of vegetation. These portions including flight of steps were dismantled exposing the core made up of laterite blocks. The core which had also suffered was consolidated by resetting the blocks and watertightened by grouting and pointing the joints in cement mortar. Then the dismantled architectural members of the plinth were reset as per the original. In addition, ten architectural members from the stacked lot were identified and fixed in their original position. However, altogether one hundred and fifty (150) stone members were reset in their original place in the process of conservation.

WESTERN FAÇADE—In the western façade on the northern side at the false window, joints of the masonry had widened due to dislodgement of members. Therefore, the affected area was dismantled and was then reset as per the original. The dislodgement was so severe that fifty-seven (57) architectural members had to be dismantled and reset (pl. IX).

South-west Corner— The stone members of the wall at the south-west corner of the structure had dislodged from their original position. These members had to be placed in their original position. Therefore, the portion with fifteen (15) members was dismantled and reset as per the original.

Western mandapa (Pavilion)— It may be remembered here that the pavilion between central chamber and the porch was without any roof. However, several architectural members of this roof could be identified from the stack at the site. By providing roughly shaped laterite blocks for missing members, the identified original members were fixed in their proper position (pl. X). Thus the pavilion *(mandapa)* was provided with roof. Altogether eighty (80) original members from the stack could be fixed in their positions by using forty-five (45) laterite blocks.

Torana on Northern mandapa (Pavilion)—This *torana* was missing. However, the decorated members of it could be identified from the stacked lot and these (10 members) could be put in their original positions.

Southern Entrance Porch—In this porch some of the members were missing and these could not be identified even in the stack. Therefore, with a view to watertightening the roof, the missing members were cast in RCC and fixed in position. Thus, the roof has been watertightened.

In addition, the flooring of the structure was conditioned wherever necessary. Further, the entire structure was watertightened by grouting and pointing the joints in cement mortar.

(b) Northern Library

North-east corner—The verandah with semi-vaulted roof at north-eastern corner was in a dilapidated condition. In fact, joints in between the masonry had widened due to dislodgement of architectural members. Therefore, a certain portion had to be dismantled and reset as per the original (pls. XI-XII). Altogether, nine (9) members were dismantled and reset. In addition, fifteen (15) members of the roof which were lying in a stack nearby were identified and fixed in their original positions.

Northern side— The architectural members of the plinth on the northern side of the library had dislodged very severely due to heavy vegetational growth. Therefore,the plinth was dismantled to a length of 10 m. After consolidating the core which had also suffered due to penetration of roots and percolation of rain water, the dismantled members were reset in their proper positions. While conserving this portion altogether fifty-three (53) members were dismantled and reset.

Western Porch—The entire roof of the western porch had come out of its original position since the pillars and beams had gone out of plumb. In the process of conservation,the roof was dismantled and then the pillar and beams were fixed in their original position. Thereafter the dismantled roof was reset. In addition, the main *torana* was also restored. Altogether twenty-three (23) architectural members were handled while conserving.

Mending and Casting of Architectural Members—Seven (7) pillars which had cracked were mended and strengthened by providing concealed steel belts. In addition four (4) missing pillars and

another one which was damaged beyond reuse, but which were essential from the point of view of strengthening the monument and restoring the missing portions, were moulded in RCC in matching colour.

Ten (10) tie-beams which had cracked were also strengthened by providing concealed steel dowels (pl. XIII). In addition one broken lintel of the window of southern porch on western side was mended and strengthened by providing concealed I-section girder.

Due to the above mentioned mending and moulding of missing members, fifty (50) architectural members from the stack nearby could be identified and fixed in their original positions in many parts of the structure.

In addition, all the four stepped entrances on four sides were also reconditioned (pl. XIV). Whole monument was watertightened by grouting and pointing the joints. The flooring of the structure was also conditioned (pl. XV).

4. ESPLANADE (RANGA-MANCHA)

(a) North-eastern and North-western Corners

The dilapidated portions of the structure were dismantled, as the architectural members had dislodged from their original position due to heavy growth of vegetation. After consolidating the core, which had suffered due to the penetration of roots and rain water, by providing missing blocks of laterite and grouting and pointing the joints,the dismantled architectural members were reset in their original positions (pls. XVI-XIX). Altogether eighty-two (82) members were dismantled and reset while conserving these portions.

(b) Southern Stepped Entrance

The southern stepped entrance was also in a dilapidated condition due to above mentioned reasons. The steps were reconditioned by dismantling twenty-two (22) members which had severely dislodged, and resetting after consolidation of core (pl. XX).

(c) Flooring

Stone-slabs paved flooring on the south-eastern corner of the structure was in a very bad condition due to dislodgement of the members. The flooring was reconditioned by removing the slabs and relaying them in proper position after providing proper base. Altogether forty (40) members were dismantled and relaid (pl. XXI).

In other parts of the structure also the flooring wherever it had suffered was reconditioned. In the process of reconditioning sixty-two (62) floor-slabs were removed and relaid (pl. XXII).

(d) Naga-railing

The *Naga*-railing was conserved to a length of 20 m (having forty-three (43) members) by resetting the uprights and the horizontal members in their proper positions.

(e) Mending of Pillars

Four circular pillars which had broken were suitably mended and reused in the reconstruction of certain portions.

5. THIRD ENCLOSURE

(a) Western and Northern Stepped Entrance and Porches at North-west Corner

The two entrances with continuation of massive plinth as balustrades were in dilapidated condition due to heavy growth of vegetation, and due to which the architectural members of the structures had dislodged from their original positions. Even the porches had gone out of plumb. The dislodgment of the members was so severe that it was not possible to conserve the structures without dismantling some of the portions. Further, the roots of vegetation had penetrated in the core of the structure and the rain water was flowing into the core and damaging it. In the first instance, therefore, the porches were dismantled, and thereafter the affected portions. After removing the roots and consolidating the core made up of laterite blocks and plugging the joints and cavities, the dismantled portions were reset as per the original. Altogether two hundred and ninety (290) architectural members were dismantled and reset as per the original. Finally, the structures were watertightened by pointing and grouting the joints.

(b) Stepped Entrance Porch between North-west corner and Western Central Entrances

As in the case of the above mentioned structures, this entrance porch was also conserved by dismantling some of the portions and resetting after consolidating the core. In the process of conservation altogether three hundred and eighty (380) architectural members were dismantled and reset as per the original. Thereafter, the whole structure was watertightened by grouting and pointing the joints.

(c) Western Central Stepped Entrance Porch

This stepped entrance porch was in a fairly good condition. However, as a precautionary measure, the entire structure was thoroughly watertightened by grouting and pointing the joints.

(d) Stepped Entrance Porch between South-west and Western Central Entrance Porches

This structure, like the above mentioned one was also watertightened by grouting and pointing.

(e) Western Stepped Entrance Porch at South-west Corner

This stepped entrance porch had suffered extensively due to heavy growth of vegetation which had dislodged the architectural members. Even the core had been damaged due to the penetration of roots and rain water. The portion which had been badly dislodged had to be dismantled to consolidate the laterite core by resetting the laterite blocks and watertightening the joints and crevices in the core. After consolidating the core, the dismantled portion was reset. Altogether three hundred and thirty (330) architectural members were dismantled and reset as per the original.

(f) Northern Central Stepped Entrance Porch

The structure was in a dilapidated condition due to dislodgement of architectural members. Vegetation was growing freely over the structure. This vegetational growth was the main reason for the pathetic condition of the structure. In addition, roots had penetrated into the core and rain water was flowing into the core and eroding the core material. Therefore, the structure had to be dismantled completely to expose the core made up of laterite blocks. The core thus exposed was in the first instance cleared of all roots and loose earth. Then the laterite blocks of the core were reset as per the original. The missing and damaged blocks were replaced by new ones cut into size. The gaps and joints were thoroughly grouted so that the roots and water would not penetrate into the core in future. After consolidating the core, the structure was reconstructed by using the dismantled members (pl. XXIII). Then the whole structure was watertightened by grouting and pointing. Altogether two hundred and thirty-five (235) architectural members were dismantled and reset as per the original, while conserving this structure.

(g) Northern and Eastern Stepped Entrance Porches at North-east Corner

These two stepped entrance porches, as in the case of the above mentioned one, had to be dismantled and reconstructed after consolidating the core. In the process of conservation, altogether four hundred and twenty-two (422) architectural members were dismantled and reset as per the original. Then the two structures were watertightened by grouting and pointing the joints.

(h) Stepped Entrance Porch between North-east Corner and Eastern Central Entrance Porches

This porch with stepped entrance was also dismantled and reconstructed, as in the case of the above mentioned porches. Altogether two hundred and fifty (250) architectural members were dismantled and reset as per the original.

(i) Eastern Central Entrance Porch

The main central entrance on the east has two porches of different heights. The first entrance porch is smaller in size. This porch standing on high platform projecting from higher porch on the east has no stepped entrance with balustrades as in the case of other porches. Possibly this entrance porch was used by the members of the royal family who came on elephants. They could directly enter into the porch after getting down from the elephants.

In this case only the tront porch had gone out of plumb due to dislodgement of architectural members of the porch as well as *adhisthana* (plinth) and flooring. Therefore, entire structure upto the platform had to be dismantled and after consolidating the core, it was rebuilt. In the process altogether seventy-two (72) architectural members were dismantled and reset. The structure was watertightened thoroughly by grouting and pointing the joints.

It may be mentioned here that the two front pillars were not found suitable for reuse in the construction of the porch, as they had been damaged beyond strengthening. But, fortunately, the base portions were reasonably strong enough to be reused. Therefore, the damaged column portions were

carefully cut and removed, and on the original bases the RCC columns were recast *in-situ*. Of the remaining other two pillars, one was in good condition and the other which was strengthened by providing concealed I-section girder in the column. Thus, the four pillars were used in the reconstruction of the porch (pl. XXIV).

Another interesting conservation problem encountered in this entrance was that some of architectural members of the platform *(upana)* had been dislodged from their original positions. Due to this the joints of the masonry had widened. Further, it was not possible to reconstruct the porch over this disturbed platform in its original position without putting the dislodged members in their positions. But a careful study showed that the members could not be dismantled without disturbing the intact portion of the higher porch. It was also observed that the members had dislodged not due to any sinking of the foundation but due to heavy vegetational growth.

It was felt that it was not possible and also not advisable to dismantle the entire portion including dislodged stones and the intact portion of the second porch. It was also thought that it is possible to push back the dislodged stones to an extent which would facilitate the reconstruction of the dismantled portion of the porch as per the original. However, it was not an easy task to push back the stones to their original position. An improvised method had to be adopted for this purpose.

The method adopted was very simple. Strong and sturdy logs were fixed in the ground upright at a suitable distance from the members to be pushed back. Then a platform of scaffolding was provided to the required height between the upright logs and the platform. Wooden blocks and jacks were fixed horizontally in between the vertical log and the member to be pushed back. Then the jack was operated slowly and cautiously to push the member to its original position. Thus, all the dislodged members were pushed to their original positions without any damage (pl. XXV).

(j) Southern Gallery on Eastern Side (Samudramanthana Gallery)

Superstructure— It may be remembered here that the French Conservation team (EFEO) had dismantled the entire gallery including the flanking entrance pavilions but excluding the rear wall with bas-relief panel depicting *Samudramanthana* or Churning of Milky Ocean by gods and demons, in 1960s, with a view to conserving the structure. However, the reason for taking such a drastic step of dismantling the whole gallery is not known, as the pre-conservation graphic and photographic documentation records are not readily available for reference. However, the French team had reconstructed the dismantled structure upto plinth *(upana)* level. They could not continue the work as they had to leave the country around 1970 due to civil war conditions.

Fortunately, the architectural members had been stacked systematically in the open area in the east. It could be discerned that the roof of the gallery had been divided into eleven convenient parts, and then it had been dismantled part by part, but giving running numbers to the dismantled stones. Thus, the numbers were continued to the next part while dismantling. Likewise, all the eleven parts had been dismantled, numbered and systematically stacked. Further, the numbering of the

architectural members was so excellent that there was no room for ambiguity. For example, each stone was bearing three numbers engraved on three sides. The number on the top indicated the layer and its position and the numbers on two sides were of adjacent architectural members. Another important clue provided for reconstruction of the gallery was that in the flanking pavilions the stones of each layer facing the gallery were bearing the beginning numbers of the architectural members to be used in the reconstruction. Thus, after understanding clearly the method of documentation of French team, it was easy to identify the architectural members and their proper position in the gallery to be reconstructed.

The French team, as mentioned earlier, could reconstruct the dismantled gallery upto the plinth level before abandoning the work. However, unfortunately, some errors had crept in, which had to be faced while executing further reconstruction work. For example, the top level of the plinth is not in perfect horizontal line. Instead it is nearly 5 cm higher at the centre and gradually descends on sides to its original level. It is needless to say that maintaining horizontal level was very important as the outer pillars of the semi-vaulted roofed verandah rests over it. Obviously, if the plinth is not in level, the superstructure including pillars, beams and roof members could not be placed properly. Therefore, this problem had to be solved.

Dismantling and reconstructing once again the plinth was obviously out of consideration. Likewise, chiselling out the bulging portion of the plinth at the centre was also not considered as a sound proposition as the topmost layer of the plinth is moulded and decorated wth carvings. Therefore, only alternative left was to dress up suitably the pillars either at the base or at the top or at both ends, depending on the length of the pillars to be reduced to keep up the horizontal level of the beams which would be fixed over them.

Further, the French team with the intention of providing strong foundation to the inner main pillars of the gallery, had constructed wall-like structure in RCC below the level of the pillar bases. In this case also the wall-like structure was protruding nearly 5 cm above the original level. This protruding portion had to be cut to obtain perfect level to fix the pillars in their proper position.

Another problem to be faced was in the form of RCC ring-beam provided by cutting a deep and wide channel over the rear wall of the gallery. Incidentally, it may be remembered here that from the section drawing published in *Angkor Wat En Peril* by Albert Le Bonheur, it appears that the French team had thought of replacing the original roof of the gallery (laid by corbelling of roof stones) with an RCC vaulted roof, and cut the original roof stones in thin slabs and fix them on the exterior only as original ornamental pieces to give original look, as they had done at temple called Vat Adiviya. The RCC vaulted roof would have been provided over the ring-beam. But this project could not be pushed through, obviously due to shortage of time. However, that the French team was bent upon executing this work is evident from the fact that more than twenty (20) roof stones had been shifted to the workshop which it had established in the jungle near the monument for the purpose of cutting thin the architectural members.

However, even the ring-beam provided on the rear wall have considerably slipped out of its alignment on the southern and northern ends of the wall. As a result, the sides of the channel cut for fixing the ring-beam had fractured at many places. The affected portions of the ring-beam, therefore, had to be chiselled out and relaid after realigning the dislodged stones in their proper position.

While reconstructing the gallery, it was found that five pillars and two beams of the gallery were either decayed beyond repair or were missing. They were cast in RCC and used in the work. However, it was ensured that they match the original members in colour and texure. Even the decorative motifs on the original members were reproduced.

It is interesting to know that the tie-beams of the verandah with semi-vaulted roof are made up of two parts, one projecting from the main pillar and the other from outer pillar to the projected part. However, the two parts are not bound together. Therefore, concealed steel clamps were provided to bind the two pieces, so that the thrust is distributed to the main pillar.

Thus, the Samudramanthana gallery was reconstructed by using more than one thousand four hundred and twelve (1412) architectural members including pillars, beams, roof stones, etc. (pls. XXVI-XXVII). The work had to be carried out very carefully as the members had decayed considerably due to weathering as they were lying on the ground in the open for more than two decades. In fact, the lower surface of almost all the members had weathered and flaking while handling, as they were in direct contact with the ground. In addition, some of the architectural members had been broken due to vandalism. However, such members were suitably strengthened and mended before reusing them in the reconstruction.

FLOORING—It may be recalled here that the French team while dismantling the *S*amudramanthana gallery had dismantled flag-stones of the flooring, probably for providing strong basal bed to the pillars and to provide drainage system. However, while reconstructing, as stated earlier, an error had crept in. The plinth was nearly 5 cm higher at the centre. This error posed problem in the relaying of the floor and maintaining the height of the floor. The problem was whether the flooring should be at the original level or it should be at the raised level. Three alternatives were considered. They are : (a) to raise the level of the floor corresponding with the existing plinth, (b) to maintain the original level of the floor but with a covered drain, and (c) to chisel off the plinth to the level of the original floor. All the three alternatives had their own advantages. For example, if the level of the floor had to be raised to the plinth level even the undisturbed stones had to be dismantled. By this process we would be unnecessarily meddling with the original well settled basal bed of the gallery. Even then the flagstones close to the wall could not be dismantled as they are part of the wall. Further, it should remembered that the wall itself is of single stones masonry. In addition the base of the pillars would be covered by the floor, and also a channel-like depression would be formed near the wall as the stone going into the wall cannot be removed and reset. Even if the channel-like depression is filled with RCC slabs to the height of the raised floor level, so that water does not stagnate, this additional thickness of slabs would cover certain portion of the panel itself. Therefore, this proposal was

rejected. Likewise, third proposal, that is to chisel off the plinth to the level of the original floor, was also rejected on the ground that the exterior face of the plinth has decorative carvings. Obviously, the second proposal of maintaining the original floor level was accepted. But, instead of providing a closed channel, it was decided that the rain water could be taken to the inlets of the underground drain provided in the gallery by the French team by lowering the level of the floor slabs wherever necessary, so that the appearance would not be of a channel even though it served the purpose.

Another problem faced while resetting the flooring was that due to shifting of the plinth a little interior, while reconstructing it, each and every flooring stone had to be cut to required size to fix it in its proper position.

In the reconditioning of the floor, altogether eighty-one (81) dismantled stones were reused. In addition, all the joints and crevices have been filled with cement mortar so that rain water does not penetrate into the foundation.

WATERTIGHTENING— The roof of the Samudramanthana gallery after reconstruction was watertightened by grouting and pointing. In addition, the cornice portion from where water used to enter into gallery and would run over the bas-reliefs was also thoroughly watertightened by grouting and pointing. The joints in the masonry of the wall on the rear side were also pointed thoroughly as the splashing rain water used to penetrate through the joints into the gallery.

(k) Entrance Pavilion North of Samudramanthana Gallery

It is necessary to recall that the western part of this pavilion had already been dismantled and reconstructed to some extent several years ago before the Indian team took up work in 1986. But, unfortunately, it is not known which agency did it. However, while reconstructing, that agency had committed blunders by not taking into account the exact levels, diagonal measurements and to keep the walls and door frames in plumb. Evidently, due to these errors there were wide gaps in the wall and the door frame as well as the lintel were out of plumb. Therefore, before further reconstruction work could be taken up, the portions which were out of plumb and walls with wide gaps had to be dismantled and reconstructed properly.

Here it may be interesting to mention that the portion to be dismantled was on the inner side of the third enclosure where the cranes could not be taken for executing the work. Unfortunately, other equipments like derrick-pole were not available for easy execution of the work. Therefore, improvised derrick-poles had to be prepared from stems of palm trees and other locally available accessories. However, it was not an ideal equipment, for the stem was very heavy for quick movement and inconvenient to handle. But it was used successfully in the conservation work of this pavilion. No doubt the progress of the work was very slow because of unwieldy equipment. Moreover, the labourers had not seen such an equipment, let alone handling it in the conservation work. Therefore, the labourers who were very reluctant to handle the equipment had to be cajoled and made to understand the principles and working method of the equipment.

In the first instance the out of plumb and dislodged heavy members, thirty-eight (38) in number, of the wall were dismantled. The door frame as well as lintel were pushed back to their original position. Then, the dismantled portion was reconstructed as per the original. After reconstructing the dismantled portion, further reconstruction of the pavilion with the available architectural members was taken up and completed. Altogether, four hundred and twelve (412) members were reset in their original position in the pavilion. However, it was found that the members of some roof portions, especially on southern and eastern sides were missing even before it was dismantled by the French team.

Fortunately, though accidentally, some of the missing members, especially of the southern missing portion of the roof could be identified from the stacked stones outside the railing of the third enclosure and from inside. These architectural members were collected and reset in their proper positions (pls. XXVIII-XXX). Unfortunately, all the members were not available. Therefore, laterite blocks cut into shape had to be used in place of the missing members. Altogether twenty-six (26) original architectural members and nine (9) laterite blocks were used in the work of sealing the missing portion. However, the opening in the roof on the eastern side is yet to be attended to.

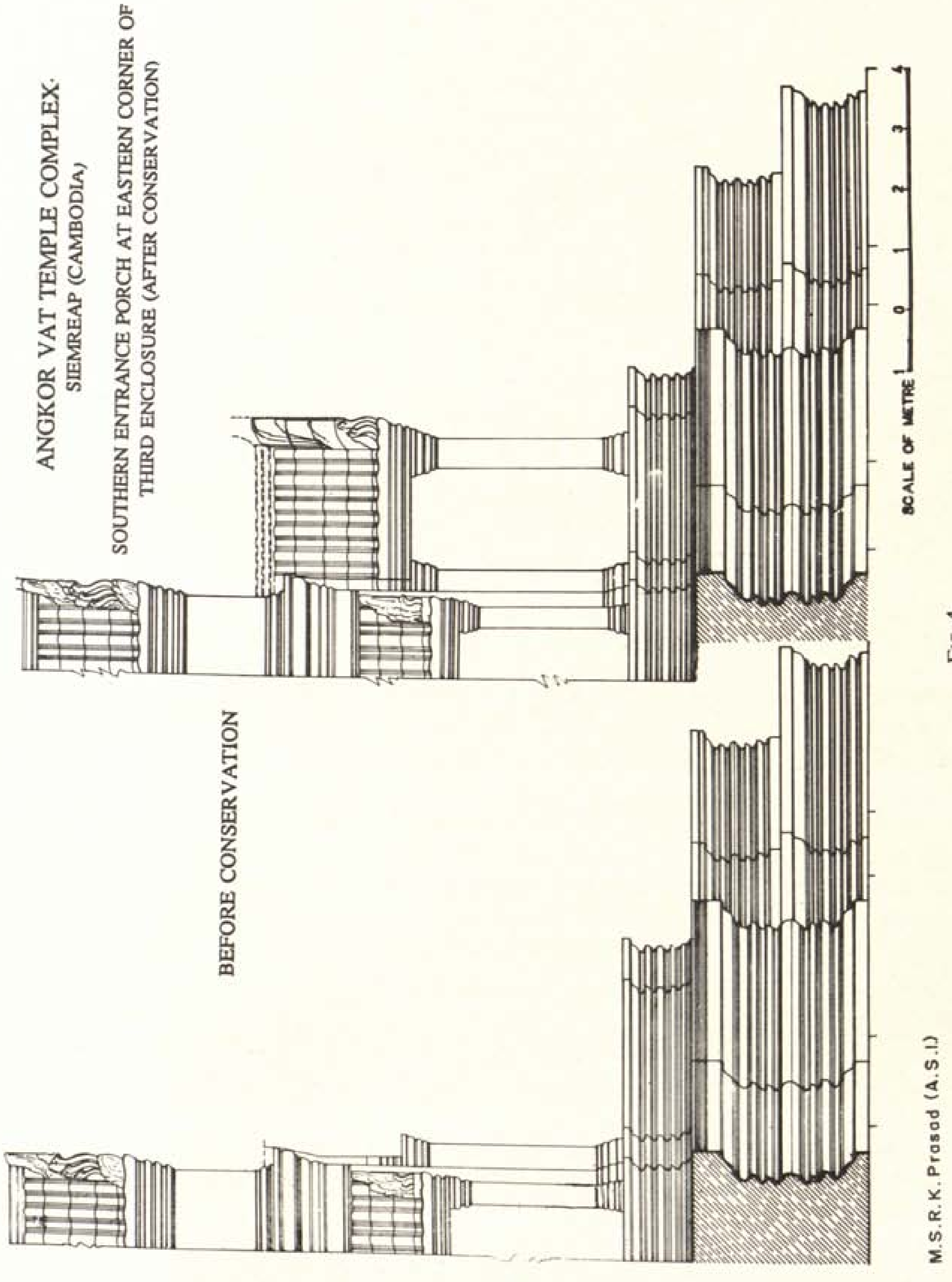
In addition, the flooring which had also been dismantled by the French team was relaid. In the process, sixteen (16) members were identified and relaid in their proper position, and for the missing four stones, suitably dressed new members were used. Then the flooring was reconditioned by dressing, grouting and pointing (pl. XXXI).

The whole structure was watertightened by grouting and pointing.

(l) South-east Corner Entrance Pavilion

This structure south of Samudramanthana gallery had also been completely dismantled by the French team before 1970, and constructed upto the plinth level as in the case of Samundramanthana gallery. Before taking up reconstruction work all the measurements of this structure, cruciform in plan were taken and marked on the plan where it had to be constructed. Care was obviously taken about the diagonal measurements. Meanwhile, the architectural members of this structure were identified. Then, the door frames were fixed in their original position. Thereafter, the whole structure was reconstructed by using more than six hundred and sixty-one (661) architectural members (pls. XXXII-XXXIII). At every stage all the measurements including diagonal ones and the levels as well as verticality were checked up. After reconstructing the whole structure was watertightened by grouting and pointing.

However, while reconstructing the structure, it was found that even big crane could not lift architectural members to the required height to restore top three courses. Therefore, a platform at the required height in scaffolding materials had to be constructed to take the stones from the crane, and then the stones had to be moved to their proper position over the wooden planks fixed on the scaffolding. This was a hazardous task as the architectural members were large in size and weighed between 800 and 2,000 kg.



ANGKOR VAT TEMPLE COMPLEX.
SIEMREAP (CAMBODIA)
SOUTHERN ENTRANCE PORCH AT EASTERN CORNER OF
THIRD ENCLOSURE (AFTER CONSERVATION)
BEFORE CONSERVATION
SCALE OF METRE
1 0 1 2 3 4
M.S.R.K. Prasad (A.S.I)

FIG. 4

While reconstructing the roof of this structure it was observed that a large gap was forming due to the missing of the original roof members. This gap was covered with RCC blocks specially cast *in situ*. Then the whole structure was watertightened by grouting and pointing.

In addition the major portion of flooring which had been dismantled by the French team with the intention to provide drainage and to raise the level of the flooring, was also relaid with the dismantled eighteen (18) stones. However, it was felt that it is not advisable to raise the level of the flooring, and, therefore, original level was maintained. The flooring was conditioned by grouting and pointing the joints as well as dressing wherever necessary.

(m) Eastern Entrance Porch at South-east Corner

This porch had also been dismantled by the French team before 1970, and had been constructed upto the plinth level. Therefore, the work had to be continued from the floor level of the porch.

The flooring was relaid as per the original by using six (6) dismantled stone members. Utmost care was taken to fill up the crevices and joints with cement mortar to safeguard from the percolation of rain water and vegetational growth. Then the two front pillars were erected in their proper position and three (3) beams were fixed over the pillars and pilasters of the entrance. The vaulted roof members of the porch were then fixed over the beams. However, it was found that many architectural members including those of *torana* were missing even before the porch was dismantled before 1970. The reconstruction of this porch was completed by using twenty-two (22) architectural members.

(n) Southern Entrance Porch at Eastern Corner

This porch on the southern side of the entrance pavilion, as in the case of the other porch, had been completely dismantled and reconstructed upto the plinth level. Therefore, in the first instance, the reconditioning of the flooring was taken up and completed in all respects by using ten (10) dismantled stone members.

Before taking up the reconstruction work of the superstructure, one of the pillars which had broken and developed vertical cracks was suitably mended and strengthened by providing concealed I-section girder and filling the cracks with epoxy resin. Likewise, the front beam which was in two pieces was also mended and strengthened by providing two (2) concealed I-section girders.

Two (2) pillars including the mended one were erected in the proper position and after fixing the beams over them, the available roof members were placed (fig. 4). It was found that the majority of members were missing even before it was dismantled by the French team. However, in the process of reconstruction twenty-one (21) architectural members were used.

(o) Southern Central Entrance Porch

This entrance porch with flight of steps flanked by massive balustrades was in a dilapidated condition. The members of the structure were dislodged due to heavy growth of vegetation. Even the porch had gone out of plumb. The *toranas* were also precariously overhanging. Therefore, the

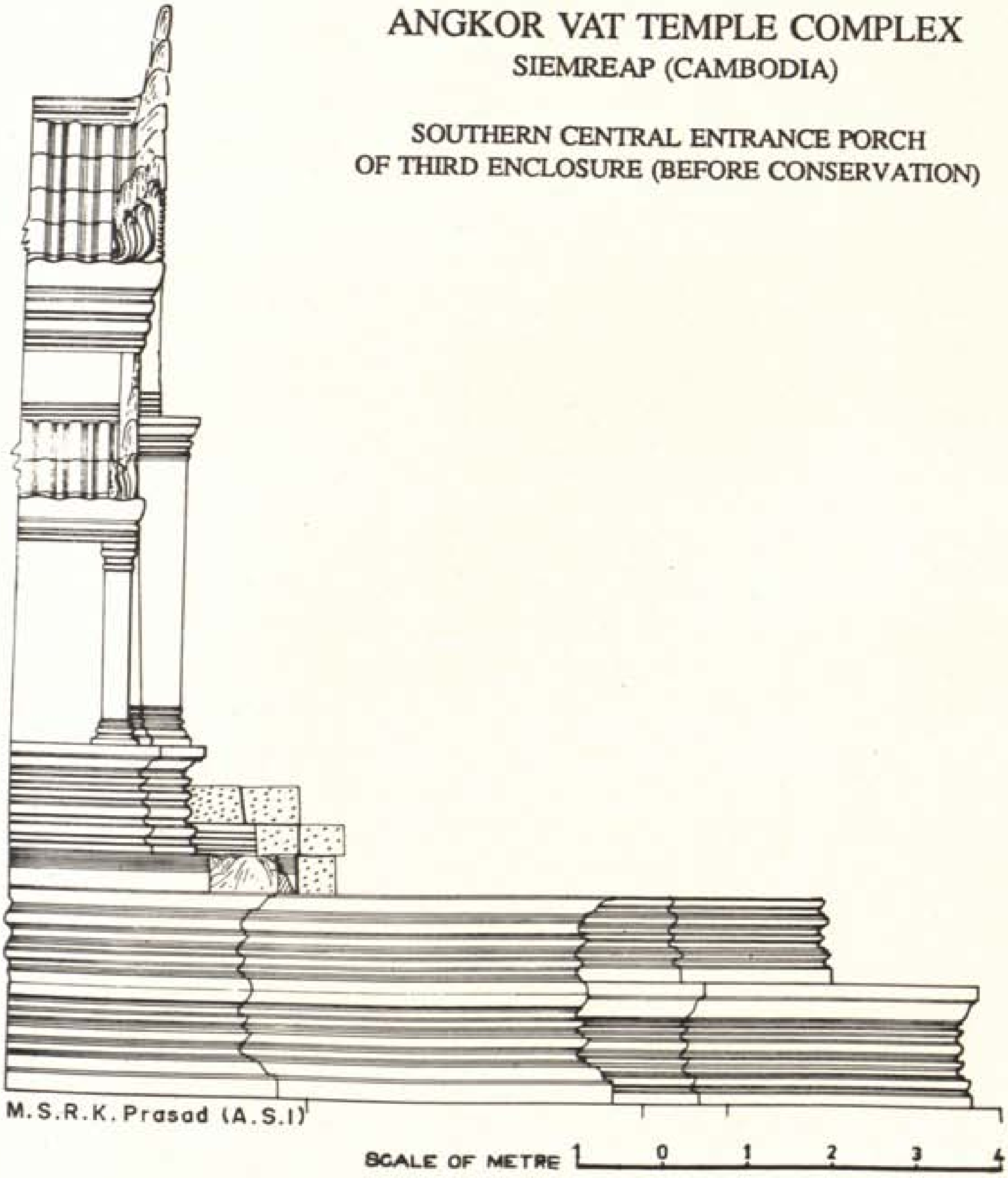

ANGKOR VAT TEMPLE COMPLEX
SIEMREAP (CAMBODIA)
SOUTHERN CENTRAL ENTRANCE PORCH
OF THIRD ENCLOSURE (BEFORE CONSERVATION)
M.S.R.K. Prasad (A.S.I)
SCALE OF METRE 1 0 1 2 3 4

FIG. 5a


ANGKOR VAT TEMPLE COMPLEX
SIEMREAP (CAMBODIA)
SOUTHERN CENTRAL ENTRANCE PORCH
OF THIRD ENCLOSURE (AFTER CONSERVATION)
M.S.R.K.Prasad (A.S.I)
SCALE OF METRE 1 0 1 2 3 4

FIG. 5b

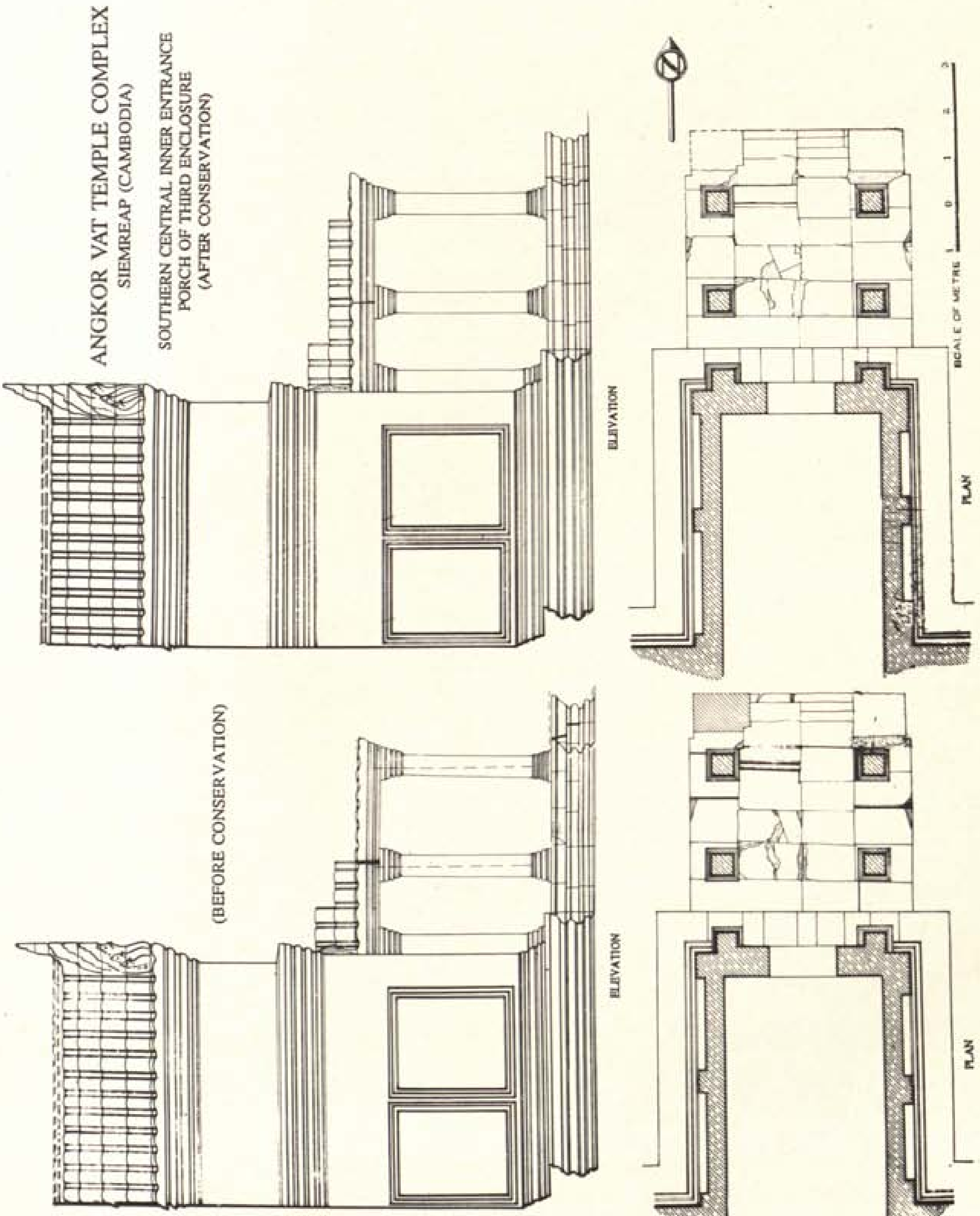

ANGKOR VAT TEMPLE COMPLEX
SIEMREAP (CAMBODIA)
SOUTHERN CENTRAL INNER ENTRANCE
PORCH OF THIRD ENCLOSURE
(AFTER CONSERVATION)
(BEFORE CONSERVATION)
ELEVATION
PLAN
ELEVATION
PLAN
M.S.R.K. Prasad (A.S.I)

FIG. 6

whole structure had to be dismantled. After dismantling the structure, the core made up of laterite blocks was made free from all roots and it was reset in its original position. The crevices and joints were grouted and pointed. Meanwhile, one of the pillars which had broken and developed vertical cracks was properly mended and strengthened by providing concealed steel belts at suitable places to avoid further development of cracks. The cavities were filled with epoxy resin.

Before taking up the reconstruction work, the architectural members of the pilaster on the eastern side of the entrance of the pavilion which had bulged out and had to take the weight of the superstructure of the porch were dismantled and reset in their original plumb line. The members were also clamped with the wall portion of the entrance as a precautionary measure. After erecting the four (4) pillars in their proper position, five (5) beams were placed over them. Then the available members of the superstructure (vaulted roof) were put in their position (fig. 5).

In addition, the decorative *torana* over the main entrance was found out of plumb and was in danger of collapsing. Therefore, the architectural members of this *torana* were dismantled and reset in their proper positions. Altogether one hundred and thirty-four (134) architectural members were dismantled and reset while conserving this porch (pl. XXXIV). The structure was thoroughly watertightened by grouting and pointing so that no vegetation grows over it.

(p) Inner Entrance Porch on Southern Side

This porch was in a dilapidated condition due to heavy growth of vegetation. Even the stone members of the flooring had dislodged. Therefore, the whole structure including plinth and flooring had to be dismantled and reconstructed. After dismantling the structure, it was found that the roots had penetrated deep into the core made up of laterite blocks. The roots were eradicated from the crevices and joints in the core and then all the crevices and joints were grouted and pointed, so that the vegetation would not grow once again in the future. Thereafter, the plinth and flooring were reconstructed. After erecting the pillars in their proper positions, the superstructure including beams and vaulted roof was reconstructed (pl. XXXV). Then the structure was watertightened.

Altogether forty-eight (48) architectural members were dismantled and reset as per the original. In addition, three (3) members which were lying on the ground in a heap were also identified and put back in their original positions (fig. 6) in the structure.

(q) Southern inner Entrance Porch on Eastern Side

It may be recalled here that the superstructure of this porch had been dismantled long ago, but one original pillar and an RCC column for the other pillar with two beams over them were standing. Even the original pillar had vertical cracks showing the tendency of flaking. In addition, the architectural members of the plinth and the flooring had been dislodged. Vegetation was growing profusely in the gaps of the masonry. Therefore, the dismantling of even the exant portion was unavoidable.

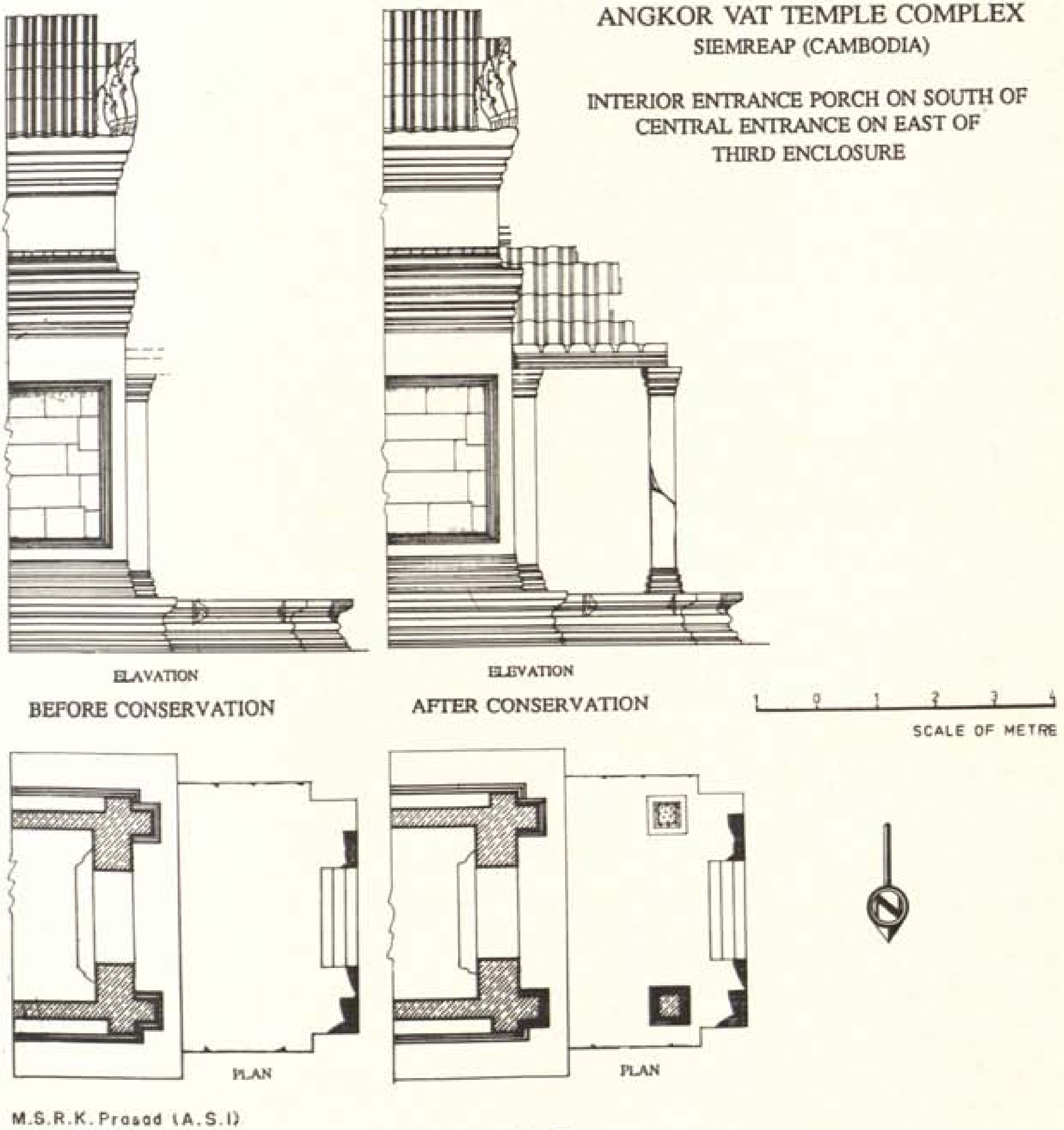

ANGKOR VAT TEMPLE COMPLEX
SIEMREAP (CAMBODIA)
INTERIOR ENTRANCE PORCH ON SOUTH OF
CENTRAL ENTRANCE ON EAST OF
THIRD ENCLOSURE
ELAVATION
BEFORE CONSERVATION
ELEVATION
AFTER CONSERVATION
1 0 1 2 3 4
SCALE OF METRE
PLAN
PLAN
M.S.R.K. Prasad (A.S.I)

FIG. 7

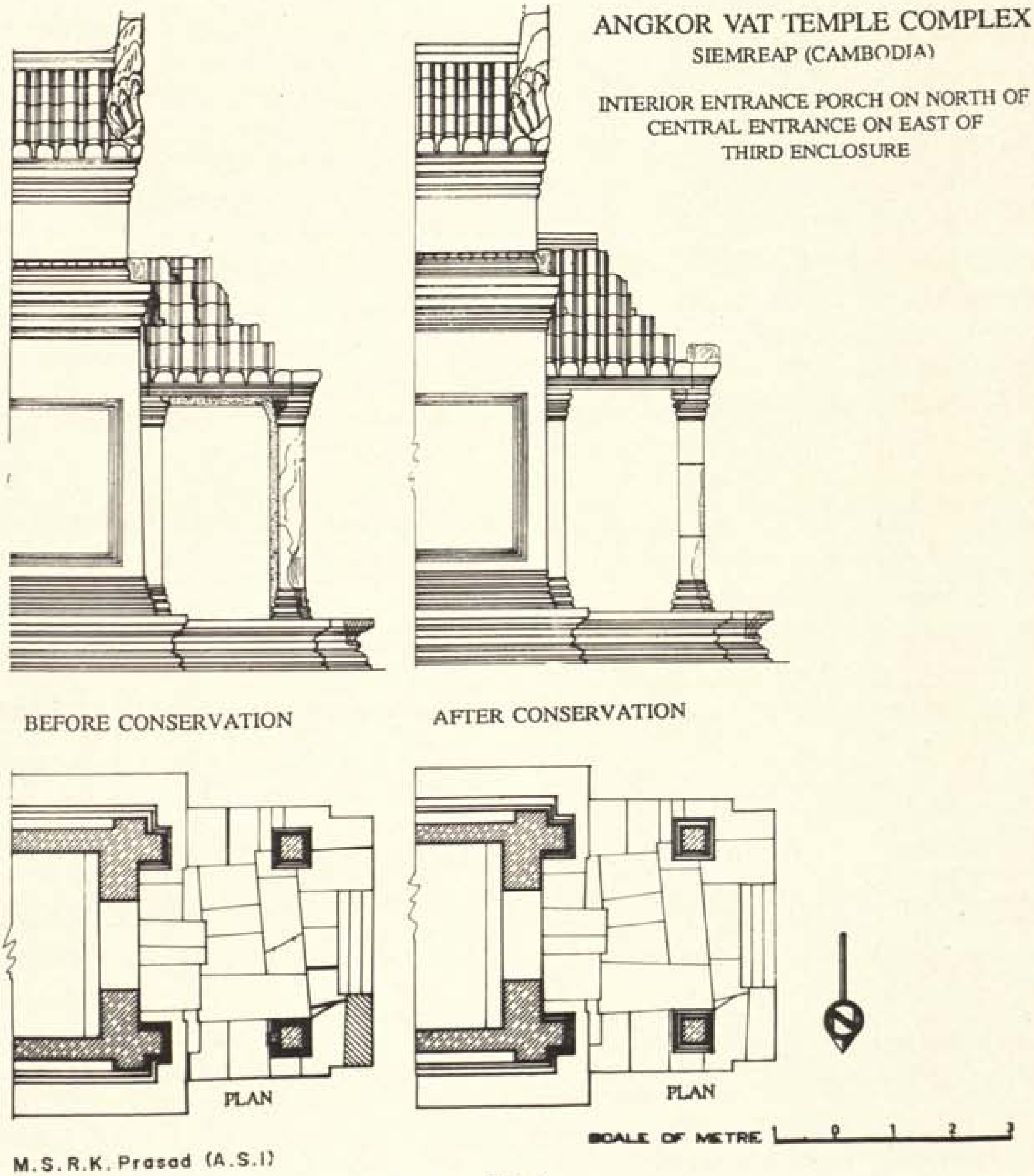

ANGKOR VAT TEMPLE COMPLEX
SIEMREAP (CAMBODIA)
INTERIOR ENTRANCE PORCH ON NORTH OF
CENTRAL ENTRANCE ON EAST OF
THIRD ENCLOSURE
BEFORE CONSERVATION
AFTER CONSERVATION
PLAN
PLAN
SCALE OF METRE 1 0 1 2 3
M.S.R.K. Prasad (A.S.I)

FIG. 8

While dismantling it was found that the plinth consisted of two moulded and decorated courses of stone and the third one was built of undecorated simple but neatly dressed stone blocks. After dismantling the plinth and the flooring, it was observed that the foundation and the core made up of laterite blocks had no sign of settling but had been disturbed due to vegetational growth. The reconstruction work was started on the original foundation as it was very sound, but it was consolidated and the crevices and joints were sealed with cement mortar. While reconstructing fifteen (15) neatly dressed stone blocks of third layer, thirteen (13) and twenty (20) decorative architectural members of second and first courses respectively were reset in their positions. Then, after consolidating the core, the floor was reset with six (6) members.

Before executing further reconstruction of the porch, the damaged pillar was suitably mended and strengthened by providing concealed steel rods and brackets. In the place of missing pillar, an RCC pillar was cast *in situ*. In addition, a beam which had broken into three pieces was mended and strengthened by providing concealed I-section girder. After placing the available two beams over the pillars, the vaulted roof was reconstructed by using fourteen (14) architectural members (refer pls. XXVIII-XXX). It may be remembered that many of the members including front beam and *torana* were missing even before it was dismantled (fig. 7). The structure was watertightened by grouting and pointing.

(r) Central inner Entrance Porch on Eastern Side

The entire porch was leaning away from the wall of the entrance of the main pavilion. Due to this, a wide gap had formed between the wall and the porch. In addition, some of the architectural members of the superstructure, plinth and the flooring had dislodged due to heavy vegetational growth. Further, one of the beams had broken and collapsed. The entire structure had, therefore, to be dismantled and reconstructed. After dismantling the porch and removing the vegetational growth from the joints of the core and consolidating it by grouting and pointing, the plinth and the flooring were reset as per the original. Meanwhile, the broken beam was mended and strengthened by providing concealed I-section girder. The two pillars which were very heavily damaged were also mended and suitably strengthened. Then the porch was reconstructed as per the original (pl. XXXVI). Altogether, sixty-four (64) architectural members were dismantled and reset while conserving this porch.

(s) Northern inner Entrance Porch on Eastern Side

This porch had the same conservation problems as those mentioned above. Therefore, the entire structure was dismantled. After removing the vegetational growth from the core of the plinth and the flooring, and grouting the joints so that there will not be any vegetational growth in future, the stone members of the plinth and the flooring were reset as per the original. Interestingly, one of the pillars had developed cracks, and from those cracks thick vegetational growth was coming out. This pillar was thoroughly mended and strengthened and made it fit for reuse. In addition, the pilasters on either sides of the entrance, which take the load of the superstructure, were suitably mended and

strengthened. Further, two members of the roof were also mended. Then the pillars were placed in their proper position, and the superstructure (vaulted roof) was reconstructed. However, it is noteworthy that thirteen (13) architectural members were retrieved from earth deposit while cleaning the area all around. Of them, only five (5) could be used in the reconstruction work. In all fifty-five (55) architectural members were dismantled and reset, and five (5) new stone members were used (fig. 8). After reconstruction the structure was thoroughly watertightened by grouting and pointing.

(t) Inner Entrance Porch on Northern Side

The architectural members of the front portion of the plinth and the flooring were dislodged due to vegetational growth. Therefore, the dislodged portions were dismantled and after removing the vegetational growth thoroughly and consolidating the core made of laterite blocks by grouting and pointing, the plinth and flooring were reconstructed as per the original. Further, the pillars and the beams of the superstructure of the porch, which had gone out of plumb, were reset in their original position. Altogether, twenty-six (26) architectural members were dismantled and reset, and another six (6) members which had been dislodged were pushed back to their original positions.

Meanwhile, three (3) architectural members of the southern topmost *torana* of the main entrance which were lying on the ground nearby were identified and hauled up and fixed in their original positions (pl. XXXVII).

(u) South-west Corner Entrance Pavilion

This beautiful corner pavilion with *gopuram*, cruciform in plan has eight walls, each decorated with beautifully and boldly carved bas-reliefs depicting stories from the *Ramayana*, the Krishna-*lila* and Indian mythology. Unfortunately, these intricately carved bas-reliefs have been damaged due to heavy weathering and flaking. This has happened primarily due to percolation of water from the roof and walls. Rain-water was freely flowing in from the gaps in the roof and walls formed by horizontal movement of the architectural members of the roof and walls. In addition, huge vertical gaps could be seen in the walls and in the corners between door jamb and walls. However, this phenomena of movement of the stones was definitely due to heavy growth of vegetation over the structure, and not in any case due to sinking of foundation or floor. Obviously, to conserve the affected areas of the structure, the architectural members of the affected portions had to be dismantled. It is needless to say that utmost care had to be taken to avoid any disfigurement of the carvings while handling the architectural members.

In the first instance, before taking up the conservation work, the bas-reliefs were consolidated by applying chemicals and by grouting and filleting with suitable cement mortar. Further, before dismantling the roof, suitable scaffolding was erected and every stone of the vaulted roof was supported from inside.

Incidentally, it is interesting to mention that while dismantling the roof members, it was noticed that this structure had been dismantled and reconstructed earlier, as the members bear the number engraved on them. It may be remembered that the French conservation team, which was conserving the monuments in Cambodia before 1970 had adopted this method of documentation. Therefore, it can be said definitely that the French conservators had worked on this structure. Further, the architectural members which were broken had been provided with unconcealed iron clamps, instead of mending them properly. In addition, the large gaps which were still existing even after conservation were filled up with cement concrete, instead of resetting the architectural members in their proper positions. Above all, the gaps in the joints were filled with fine clay and then pointed with cement mortar. This method of filling up the joints proved devastating to the structure. Because, the fine clay helped the fast growth of vegetation; it was amazing to see how the roots had spread from one joint to the other like the tentacles of an octopus, and finally engulfed the structure leading to its destruction. If the previous conservators had understood the problems and the principles of conservation, this structure would not have been in this precarious condition.

Be that as it may, coming to our effort, it was found while dismantling the roof, the architectural members, espcially of *toranas* had disintegrated and it was extremely difficult to dismantle them. Therefore, they were strengthened and mended *in situ* and then dismantled without causing any damage to them.

After dismantling three hundred and forty-eight (348) stone members of the roof and *toranas* and stacking them systematically at the site, southern wall on the west and western wall on the south, in other words southern and western arms of the south-west interior corner of the pavilion, having bas-reliefs of Ravana lifting Kailasa and *Manmathasamhara* by Siva respectively, were taken up for conservation. Among the thirteen (13) courses of the walls, the topmost two courses with nineteen (19) members were dismantled. However, the walls with bas-reliefs were not dismantled completely. Instead, those portions in which the architectural members were showing pronounced tendencies of slipping and dislodgement were dismantled. Then, in the portions where the joints between the members had become wider due to the horizontal movements, there the members were pushed back to their original position with the help of horizontal jacks. Subsequently, the dismantled members of the walls were reset in their original position.

In the process of conservation of these two walls, the roof of the exterior semi-vaulted roofed verandah had to be dismantled. Thus, in all forty-five (45) members of the walls and eighteen (18) members of the verandah were dismantled and reset. Another eleven (11) members were reset without dismantling.

Then, the southern and eastern walls of south-east interior corner were taken up for conservation. It may be remembered that there were large vertical gaps between door-frames and the walls on both sides, and the joints in the masonry had widened due to slipping of the architectural members. Therefore, as in the case of the earlier work, certain portions of the walls were dismantled and

reconstructed and wherever necessary the architectural members were pushed back to their original position by using horizontal jacks without dismantling the members. In the process of conservation sixty-three (63) architectural members were dismantled and reconstructed and another seven (7) members were reset without dismantling. In addition, fourteen (14) decorative columns of window-screen were also dismantled and reset. Thus, the bas-reliefs of Vali-*samhara* and Dakshinamurti Siva, respectively on southern and eastern walls were conserved (pls. XXXVIII-XXXIX).

Likewise, two southern, eastern and western walls of north-east and north-west interior corners were conserved. As in the case of the earlier work, some of the portions of the walls were dismantled. After resetting the slipped and dislodged architectural members of the walls by pushing them back to their original positions by using horizontal jacks, the dismantled portions were reset as per the original. In the process of conservation one hundred and sixteen (116) architectural members were dismantled and reset, in addition to pushing back sixteen (16) members to their original position. Besides, sixteen (16) decorative window columns (vertical bars) were also dismantled and reset. Thus, the bas-reliefs representing life in the ship, Krishna lifting Govardhana mountain (pl. XL), *Samudramanthana* and Bhikshatanamurti Siva were thoroughly conserved.

It is needless to say that extreme care had to be taken in the execution of this work by providing bags filled with saw-dust and rubber pads to the architectural members while handling them.

After completing the conservation of the walls of the pavilion, the dismantled architectural members of the vaulted roof and the *toranas* were reset by using five hundred and eight (508) stone members. The entire structure was then made watertight by grouting the crevices and pointing the joints. Thus, the pavilion has been conserved in all respects.

(v) Western and Eastern Galleries on Northern Side

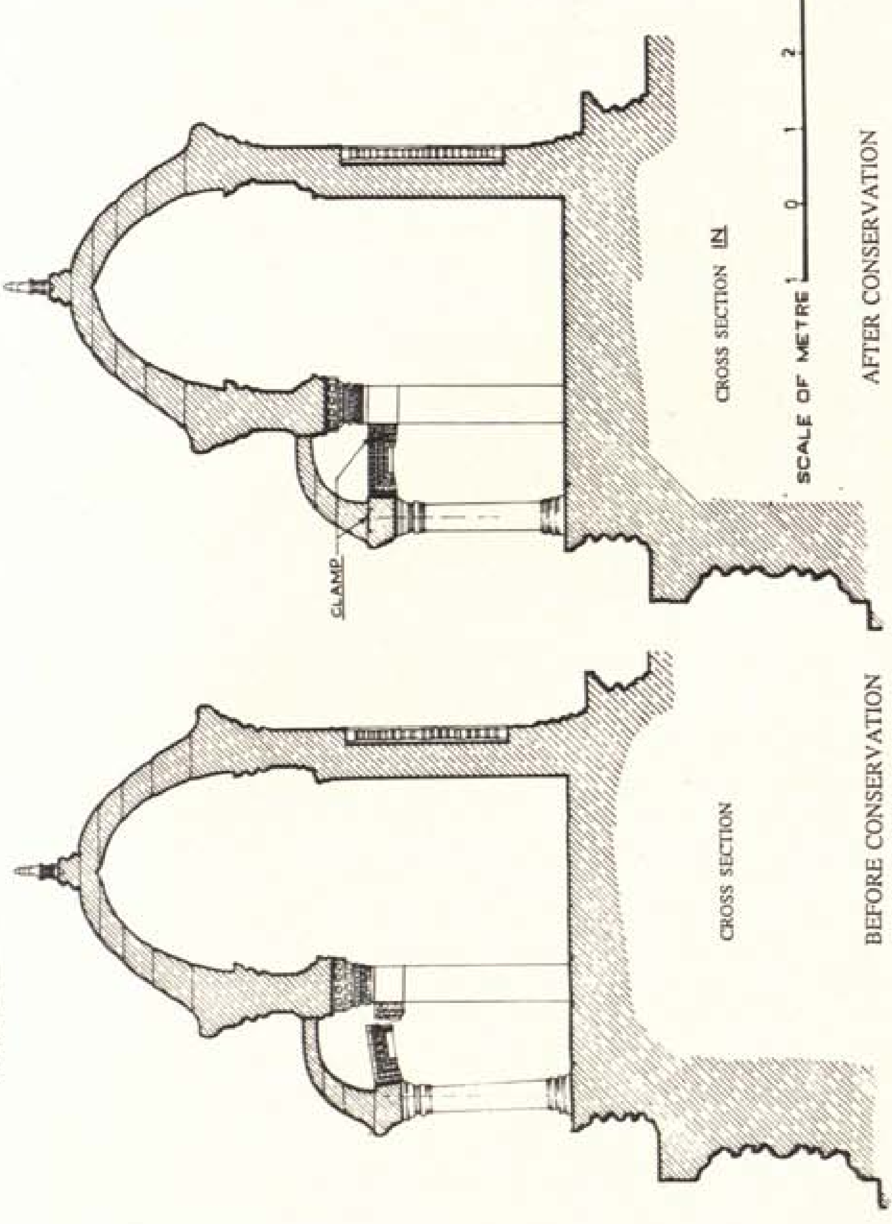
A general phenomenon observed in the galleries of the third enclosure was that all the outer pillars of the verandahs with semi-vaulted roof of the galleries were leaning out, and due to this the tie-beams were supposed to have sheared and the so-called cracks had widened. This phenomenon has generally been attributed either to the failure of the foundation or to the sinking of the main pillars of the main gallery. However, our study showed that this phenomenon was only due to an engineering error commited during the original construction. Further, the shearing or cracks in the tie-beams were not actually cracks, but each beam was made of two parts —one projecting part of the main pillar, and the other resting over the outer pillar, but connected to the projected part. Another important point to be noted is that all the snaps or cracks are obliquely cut and at a particular point in the tie-beams. There is no exception even in the gateway of fourth enclosure where it is very clear. Therefore, the crack is nothing but a joint between the two parts of the tie-beam.

Regarding the settlement of the foundation, there is no evidence of sinking or disturbance of any architectural member of the plinth. The settlement or sinking of main pillars of the main gallery cannot be accepted as there is no evidence. For example, the architectural members resting over the main pillar do not show any sign of buckling or widening of joints. They are in perfect original

ANGKOR VAT TEMPLE COMPLEX

SIEMREAP (CAMBODIA)

WESTERN WING GALLERY ON NORTH SIDE OF THIRD ENCLOSURE



BEFORE CONSERVATION

AFTER CONSERVATION

FIG. 9

M.S.R.K. PRASAD (A.S.I)

horizontal level with paper-thin joints. However, the horizontal level on the whole at the top main pillars shows little sagging at the centre of the gallery which is also significantly repeated in the original floor level. In other words, the height from the floor level to the horizontal level above the main pillar is the same at any given point in the gallery. Thus, it can be concluded that this error crept in the original construction itself. But, on the other hand, the horizontal level at the top of the outer pillars is in perfect straight line.

Furthermore, the architectural members of the top-most course of the roof of the semi-vaulted roof of the verandah are socketed into a groove cut in the main beams of the main gallery. Thus, the verandah with semi-vaulted roof was almost independent and free standing from the main gallery.

Incidentally, we may recall here that the total length of the verandah is nearly 500 m, and the total number of tie-beams is two hundred and four (204). Now, imagine, is it possible for the natural causes like foundation failure or sinking of pillars, as suggested by some conservators, to snap all the tie-beams running to such a length? Is it possible for the natural causes to act in a particular way in all the tie-beams in a particular manner, that too at a given point? Further, why the tie-beams nearer to the entrance pavilions have also snapped? Suppose, the tie-beam was of single piece of stone, then would it not be a huge rectangular sectioned hammer-like member unwieldy to handle? Would it be easy to fix such two hundred and four members in their proper positions? Therefore, it is impossible to believe that the natural causes were responsible for this phenomenon. It can be said with emphasis that the inherent constructional errors were responsible.

The ultimate consequence of these errors was that the thrust of the semi-vaulted roof, which is obviously towards exterior, could very easily dislodge the tie-beams at the joint and push the outer pillars out of plumb. Obviously, if the tie-beams were to be made of single stones and horizontal level at the top of the main pillars was to be in straight line and if the topmost roof member of the verandah was juxtaposed with the main gallery, this phenomenon would not have occurred.

Therefore, the remedy was very simple: make the tie-beams to act like one for which it was provided, and bring back the outer pillars to their original plumb and maintain the horizontal level of the tie-beams.

WESTERN GALLERY— This gallery was the most affected one in the entire complex. Here, the joints of some of the tie-beams had widened by 4 to 5 cm and the outer pillars had gone out of plumb by 2 to 3 cm. As a precautionary measure, buttresses had been provided from outside to the leaning pillars, and the iron belts had been given between outer pillar and the main pillar, by the earlier conservators sometime ago. These precautionary measures were not only giving ugly look, but they had also blocked easy access to the gallery. Therefore, this gallery which was in a precarious condition, was taken up for conservation.

In the first instance, strong suitable supports were given from inside to the upper courses of the semi-vaulted roof and tie-beam, and then the courses immediately over the outer horizontal beams were dismantled. The beams thus freed were jacked up and the pillar which became free of any load

ANGKOR VAT TEMPLE COMPLEX
SIEMREAP (CAMBODIA)
NORTHERN LIBRARY BETWEEN SECOND AND THIRD ENLOSURES
NORTHERN SIDE ELEVATION (BEFORE CONSERVATION)

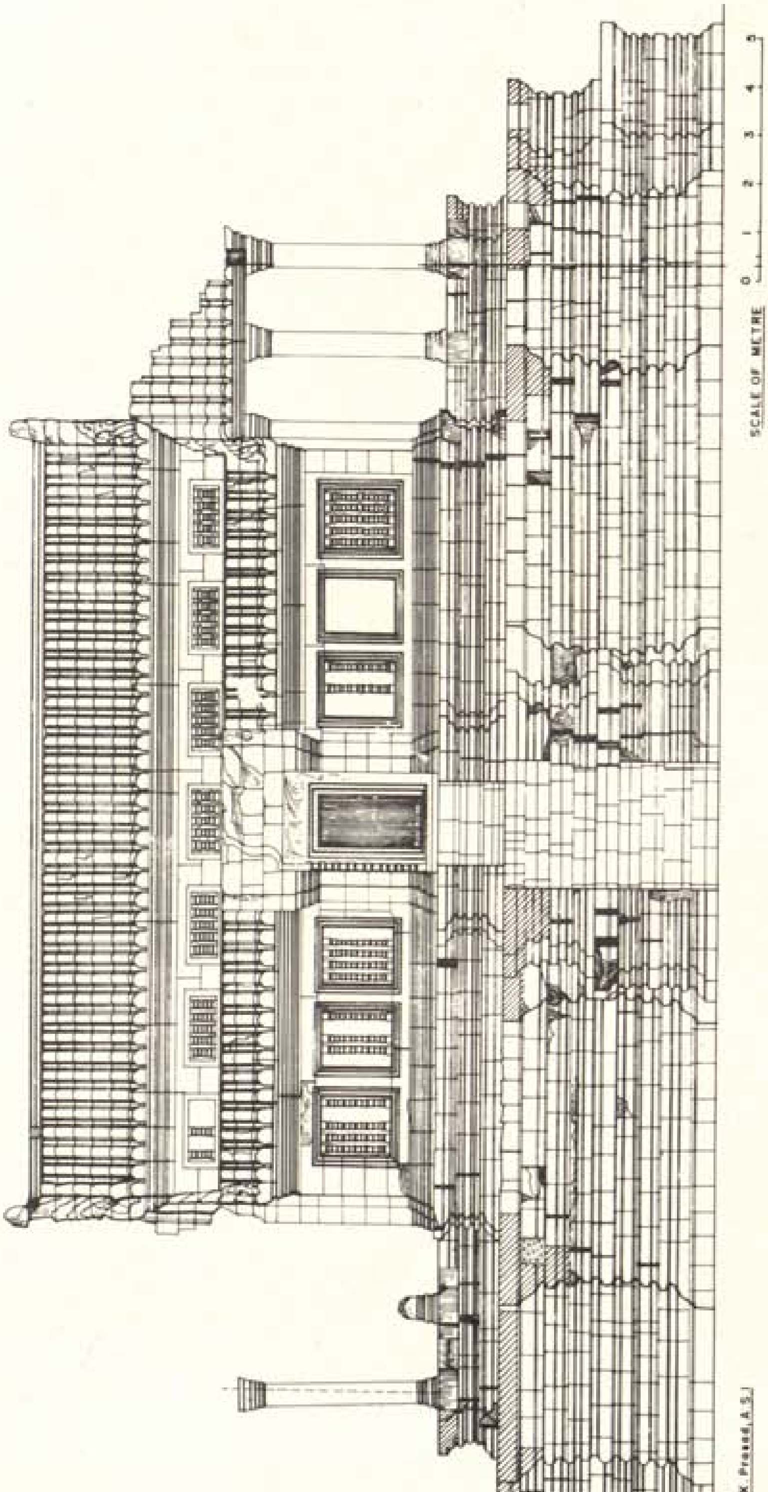


FIG. 10a

ANGKOR VAT TEMPLE COMPLEX
SIEMREAP (CAMBODIA)
NORTHERN LIBRARY BETWEEN SECOND AND THIRD ENLOSURES
NORTHERN SIDE ELEVATION (AFTER CONSERVATION)

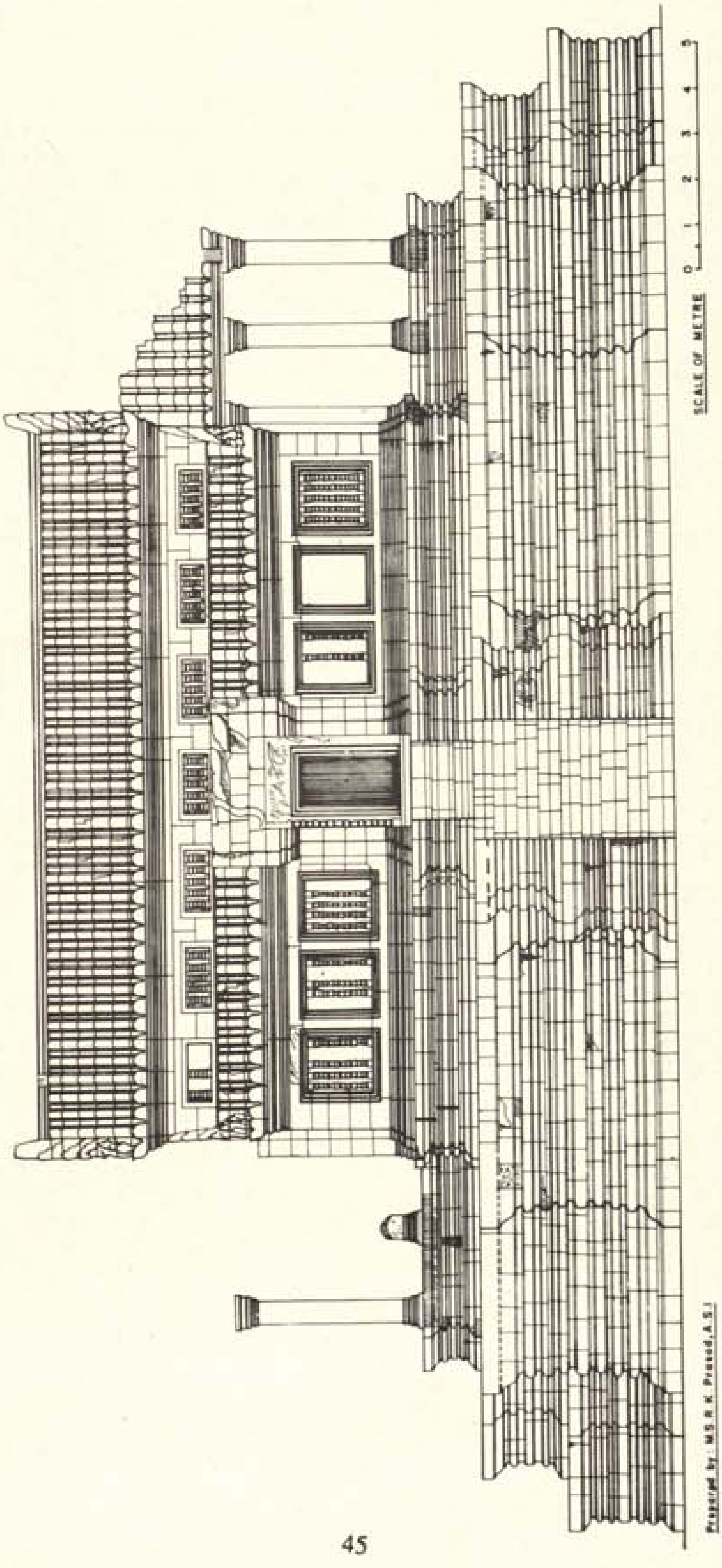


FIG. 10b

ANGKOR VAT TEMPLE COMPLEX
SIEMREAP (CAMBODIA)

NORTHERN LIBRARY BETWEEN SECOND AND THIRD ENCLOSURES
EASTERN SIDE ELEVATION (BEFORE CONSERVATION)

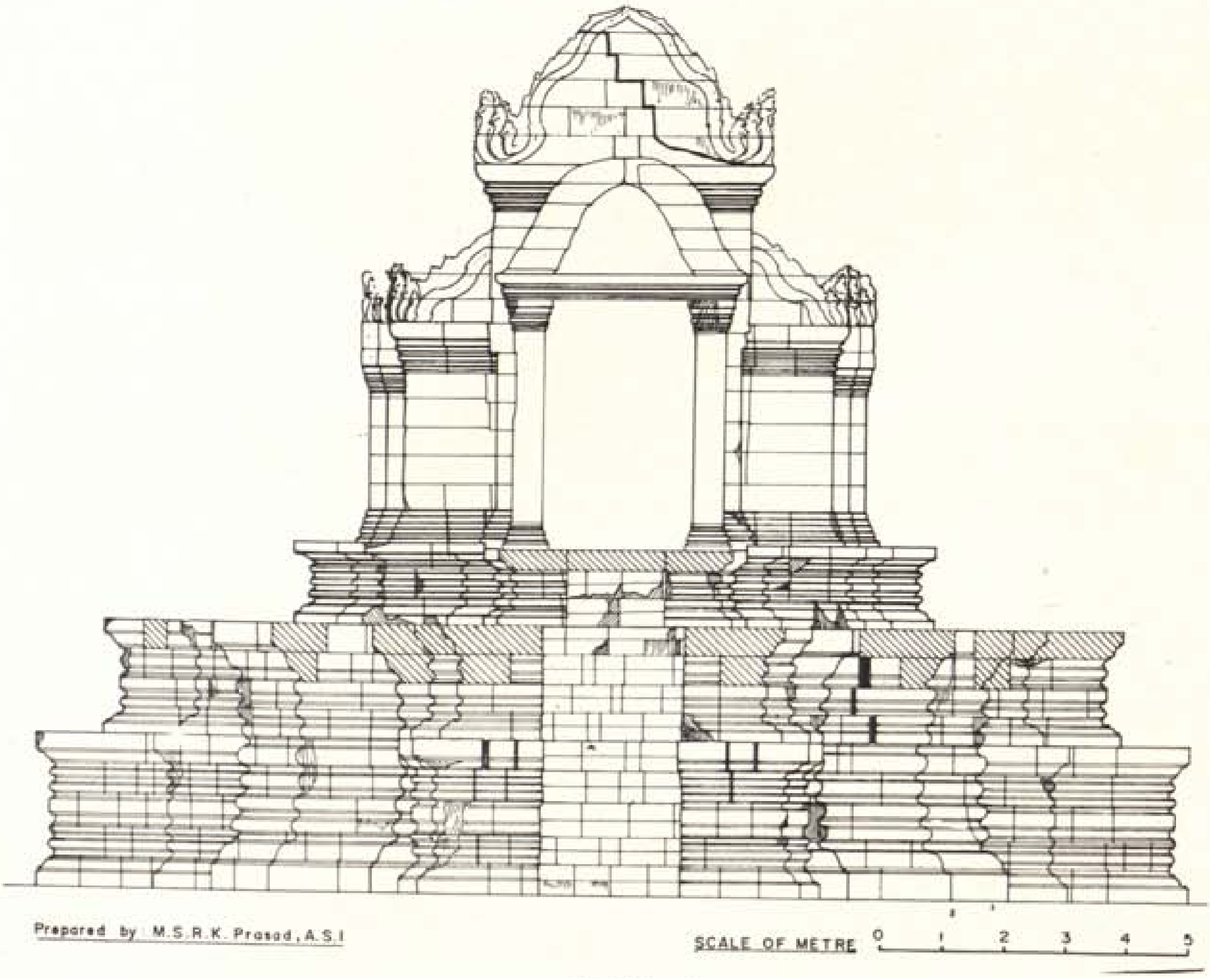


FIG. 11a

ANGKOR VAT TEMPLE COMPLEX
SIEMREAP (CAMBODIA)

NORTHERN LIBRARY BETWEEN SECOND AND THIRD ENCLOSURES
WESTERN SIDE ELEVATION (AFTER CONSERVATION)

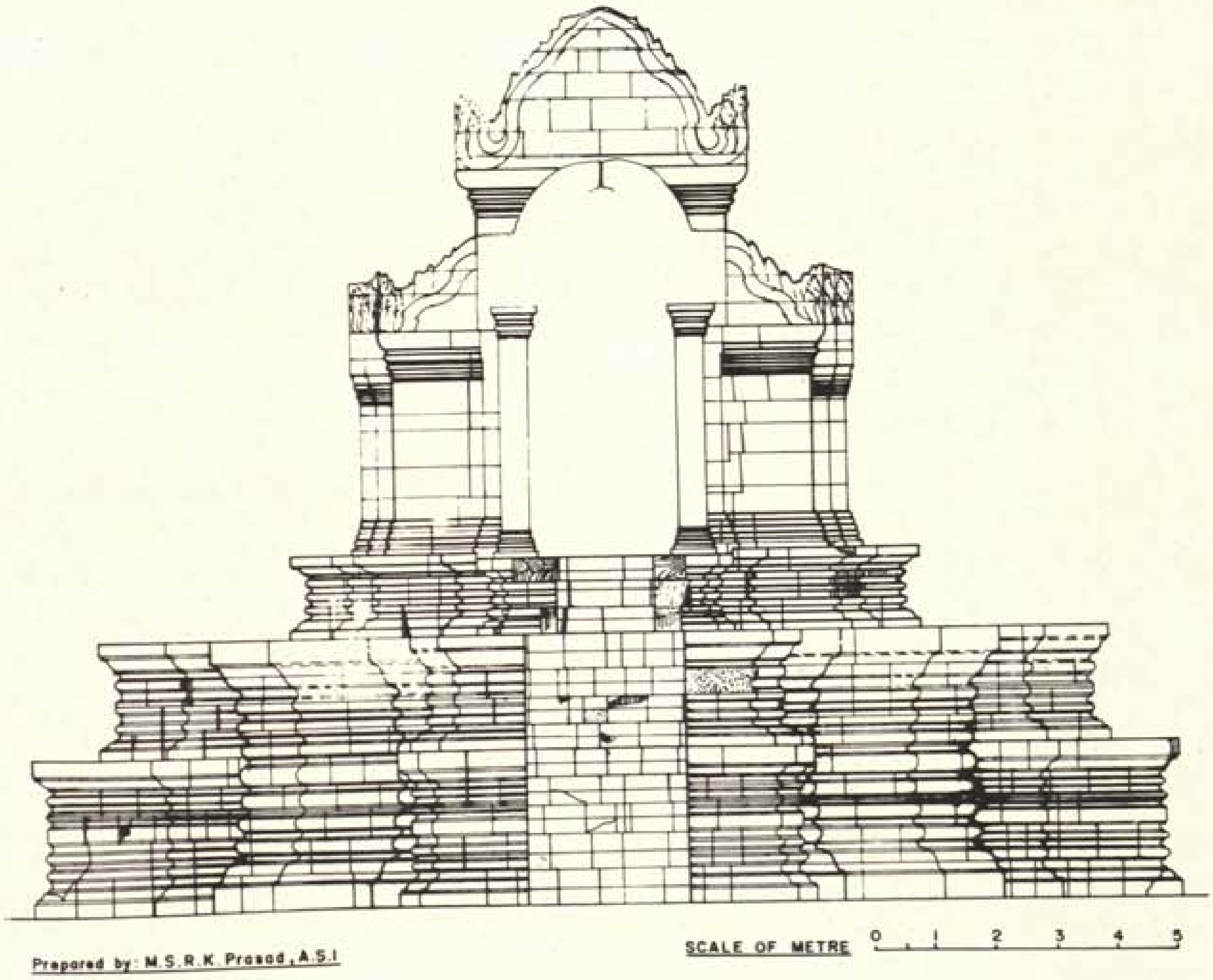


FIG. 11b

was brought to its original plumb. The beams were reset over it in their proper position. Ultimately, the tie-beam was reset in its perfect horizontal position after applying epoxy resin between the two parts of the tie-beam. In addition, to arrest the recurrence of the phenomenon in any form, steel dowels were provided in between the parts of the tie-beam, between outer beams and tie-beam and between two outer beams. Thus, all the architectural members including the main pillar share the thrust of the roof, as they are interconnected and act like one block (fig. 9). It is needless to add that all the props, buttresses and iron belts have been removed, and, now the gallery has free access, and above all, it is thoroughly conserved (pls. XLI-XLIII). Here it may be remembered that while conserving this gallery alongwith thirty-nine (39) pillars and equal number of tie-beams, two hundred and twenty-eight (228) roof stones were dismantled and reset.

EASTERN GALLERY— This gallery, consisting of 26 pillars and equal number of tie-beams had the same conservation problem as that of the above one. Therefore, the same method was adopted for conserving this gallery. However, in this gallery one of the tie-beams had weathered very badly. It was mended and strengthened by providing steel rods (pl. XLIV). A side beam had broken into two pieces. It had been supported on RCC frame. The beam in two pieces was taken down and mended and strengthened by providing concealed I-section girder. Then it was placed in its original position. The RCC frame was dismantled (pl XLV). In addition, the cracked pillars which had been bolted with iron clamps were conserved by filling up the cracks with epoxy resin and by providing concealed steel bolts. In conserving this gallery seventy-eight (78) roof stones were dismantled and reset.

(w) Northern and Southern Galleries on Western Side

NORTHERN GALLERY— This gallery having twenty (20) outer pillars and equal number of tie-beams in the verandah with semi-vaulted roof had the same problem as the northern galleries where the outer pillars had gone out of plumb and the tie-beams had widened joints. But, fortunately the problem was not so severe. Therefore, instead of dismantling some courses of roof stones, as was done in outer galleries, it was conserved by simply making free the tie-beams by providing suitable props and bringing the tie-beams to their original horizontal position and fixing the joints with epoxy resin and strengthening by providing concealed steel clamps. Further, the beams were locked with each other by providing concealed steel dowels. Thus, the gallery was conserved in all respects.

SOUTHERN GALLERY— This gallery with eighteen (18) outer pillars supporting the semi-vaulted roof and equal number of tie-beams was also conserved as was done in the case of other galleries. The tie-beams were made free by providing suitable props and then two parts of the tie-beams, outer beams and outer pillars were tied with each other by providing concealed steel clamps. Then the props were removed.

(x) Northern Gallery on Eastern Side

This gallery with twenty (20) outer pillars and tie-beams had the same conservation problem, as in the case of the above mentioned galleries on two sides of the third enclosure, though not as severe. But more serious problem in this gallery was that some of the stone members of the uppermost

course of the semi-vaulted roof had come out of the groove, and clamps were provided to arrest the recurrence of the problem. The pillars and tie-beams which had weathered were mended and the cracked beams were provided with concealed steel belts. Only twelve (12) roof members were dismantled and reset while conserving this gallery.

6. SOUTHERN AND NORTHERN LIBRARIES BETWEEN SECOND AND THIRD ENCLOSURES

(a) Southern Library

SOUTHERN STEPPED ENTRANCE—The structure was in a dilapidated condition as the architectural members had been dislodged from their original positions. Therefore, certain portions had to be dismantled and reset to bring the structure to its original shape. Altogether, twenty-four (24) architectural members were dismantled and reset, and another ten members were reset by using horizontal jacks and by human effort. In addition, seven (7) members which had been dismantled some decades earlier and stacked nearby were identified and refixed in their original positions in the structure (pl. XLVI).

NORTHERN STEPPED ENTRANCE— As in the case of the southern entrance, some of the portions of this structure were dismantled and reset, as the dislodgement of the architectural members was pronounced and vegetational growth was very deep. Altogether, eleven (11) members were dismantled and reset, and another five (5) members which had been displaced from their original position were reset as per the original (pl. XLVII).

(b) Northern Library

This structure, oriented east to west, measures 32·90 x 18·90 m. This is one of the most beautiful structures in the complex, standing majestically to a height of 14·50 m. Unfortunately, this had suffered most due to vegetational growth and negligence. Some of the portions had collapsed and on some portions the architectural members had been dislodged very severely. Therefore, this structure had to be dismantled wherever necessary and reconstructed as per the original.

SOUTHERN FAÇADE— Massive stepped entrance with flanking balustrades, plinth and landing had suffered due to heavy vegetational growth. The architectural members had dislodged severely. Therefore, major portions had to be dismantled and after consolidating the core, the dismantled portions had to be reset as per the original. Altogether, forty (40) architectural members were dismantled and reset. Another eleven (11) members which had also been displaced were fixed in their original positions with the help of horizontal jacks and by human efforts (pl. XLVIII).

The south-east corner of the massive plinth and the landing which had dislodged members due to vegetational growth were dismantled and reset as per the original. In the process of conservation altogether fifteen (15) architectural members were dismantled and reset.

NORTHERN FAÇADE—The whole northern façade (fig. 10) was in a dilapidated condition due to heavy vegetational growth. In fact, some of the portions were precariously overhanging. Therefore, the architectural members of the dislodged portions in the plinth, landings and stepped entrance

ANGKOR VAT TEMPLE COMPLEX
SIEMREAP (CAMBODIA)

NORTHERN LIBRARY BETWEEN SECOND AND THIRD ENCLOSURES
WESTERN SIDE ELEVATION (BEFORE CONSERVATION)

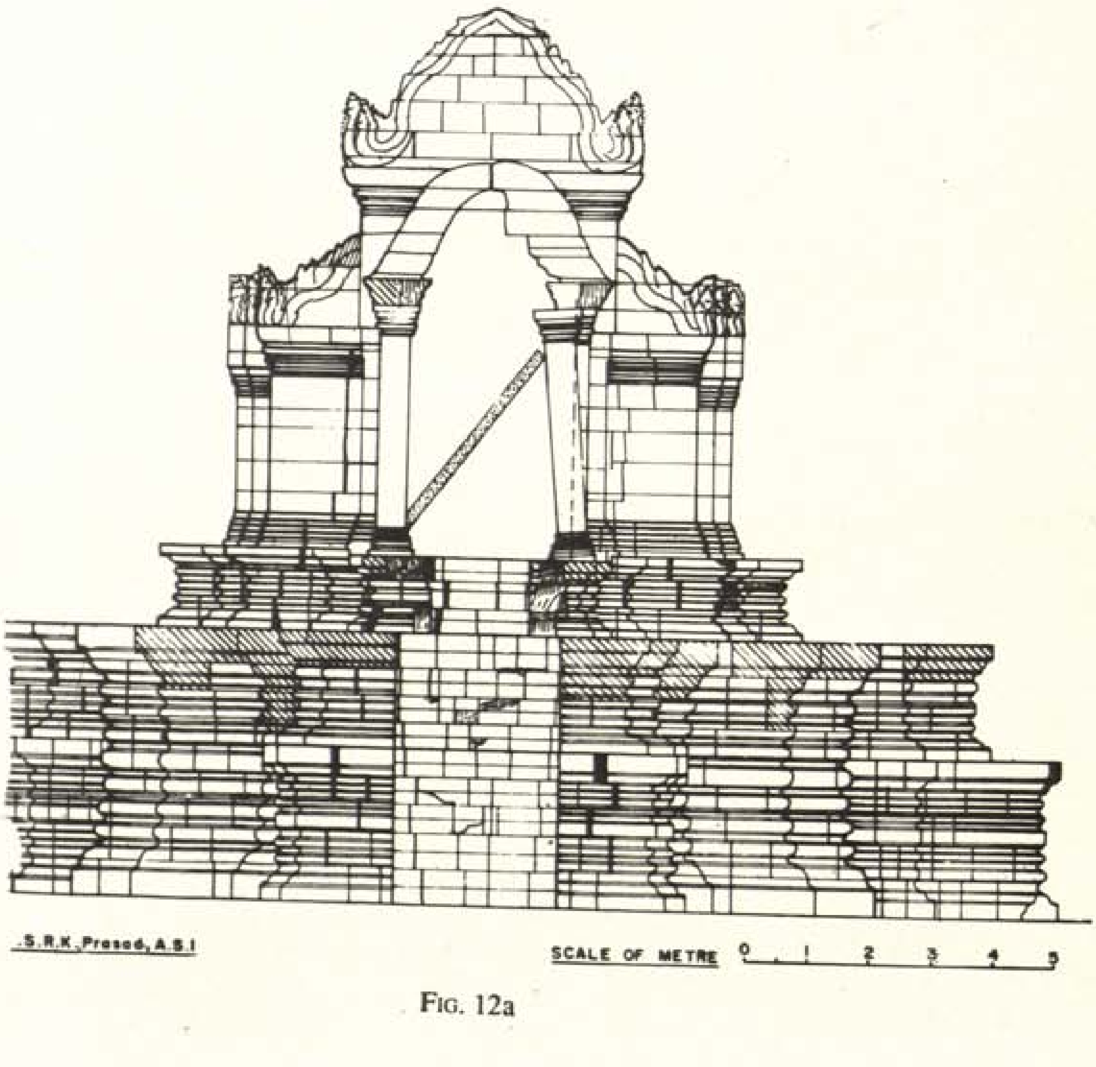
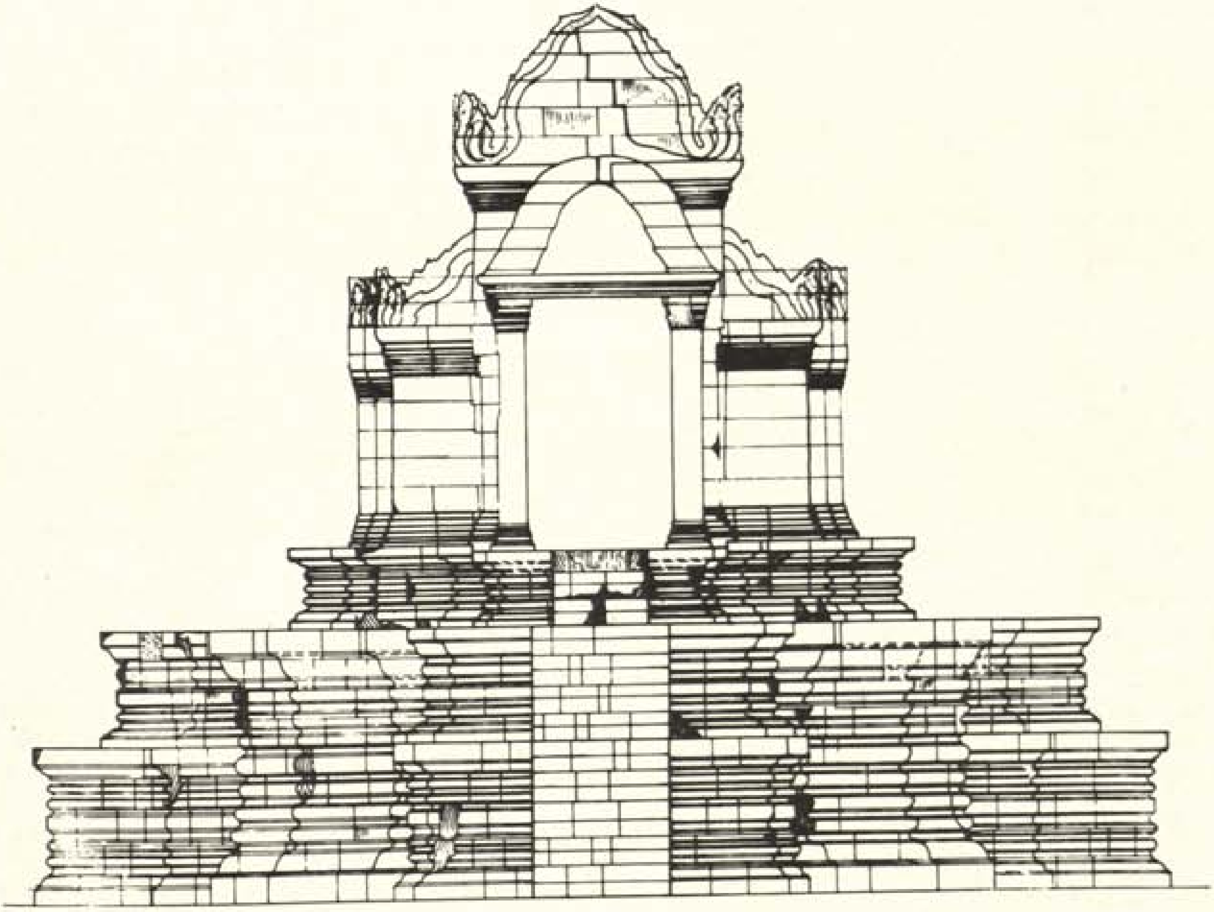


FIG. 12a

ANGKOR VAT TEMPLE COMPLEX
SIEMREAP (CAMBODIA)

NORTHERN LIBRARY BETWEEN SECOND AND THIRD ENCLOSURES
EASTERN SIDE ELEVATION (AFTER CONSERVATION)



Prepared by : M.S.R.K. Prasad, A.S.I

SCALE OF METRE 0 1 2 3 4 5

FIG. 12b

flanked by balustrades had to be dismantled and after consolidating the core made up of heavy laterite blocks, the dismantled portions were reset as per the original. Altogether one hundred and forty-five (145) members were dismantled and reset. In addition one (1) member which was lying in a heap of stones was identified and refixed in its original position in the structure.

EASTERN FAÇADE— The façade(fig. 11) including plinth and stepped entrance flanked by massive balustrades was in dilapidated condition due to horizontal dislodgment of architectural members. The dislodgement of members was so severe in some portions due to heavy growth of vegetation that such portions had to be dismantled and reconstructed as per the original after consolidation of the core which had also suffered damages. In the areas where the dislodgement was not so pronounced, the displaced architectural members were pushed back to their original positions with the help of horizontal jacks and by human efforts (pl. XLIX). While conserving this façade, thiry-six (36) architectural members were dismantled and reset and another nine (9) members were reset without dismantling.

WESTERN FAÇADE— The whole of western façade (fig. 12) including massive double plinth stepped entrance flanked by balustrades and landings, entrance porch and topmost *torana* was in dilapidated condition. Therefore, the conservation work had to be carried out with great care on priority basis in a phased manner.

(c) Topmost torana

This decorative *torana* of the vaulted roof at a height of more than 13 m was precariously overhanging and was in the verge of collapsing. Therefore, it had to be dismantled and reconstructed. But it was not an easy task as the architectural members at such a height had to be dismantled. Dismantling and bringing down the architectural members to the ground was out of consideration, because there was every possibility of damaging the decorated members while handling them from such a height. Therefore, it was decided to construct a suitable platform of wooden planks supported by scaffolding at a height of 13 m i.e., around the base of the *torana* and dismantle and stack the members over this platform. This method not only proved to be safe but also time saving.

While dismanting it was found that some of the members had weathered and were flaking and some had crushed into pieces. Such members had to be chemically consolidated and mended, as the case may be, *in situ* before dismantling.

It is encouraging to know that by adopting innovative methods the *torana* could be dismantled and reconstructed successfully. While conserving, twenty-seven (27) members were dismantled and reset as per the original (pl. L).

Meanwhile, the topmost course of the roof stones, seven (7) in number, which had been dislodged were also reset in their proper positions.

(d) Entrance Porch

This porch was in a very bad state of preservation. The southern portion had collapsed and

ANGKOR VAT TEMPLE COMPLEX
SIEMREAP (CAMBODIA)

SOUTHERN ENTRANCE PORCH OF ANTE-CHAMBER OF SECOND ENCLOSURE

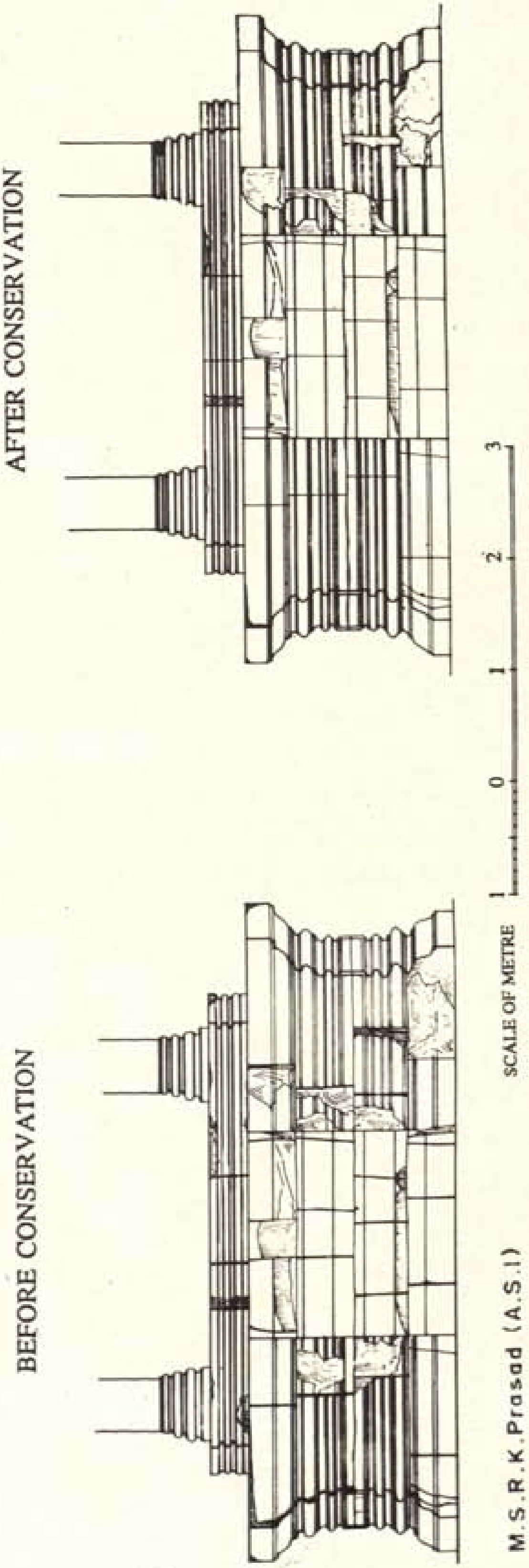


FIG. 13

ANGKOR VAT TEMPLE COMPLEX

NORTHERN ENTRANCE PORCH OF ANTE-CHAMBER OF SECOND ENCLOSURE

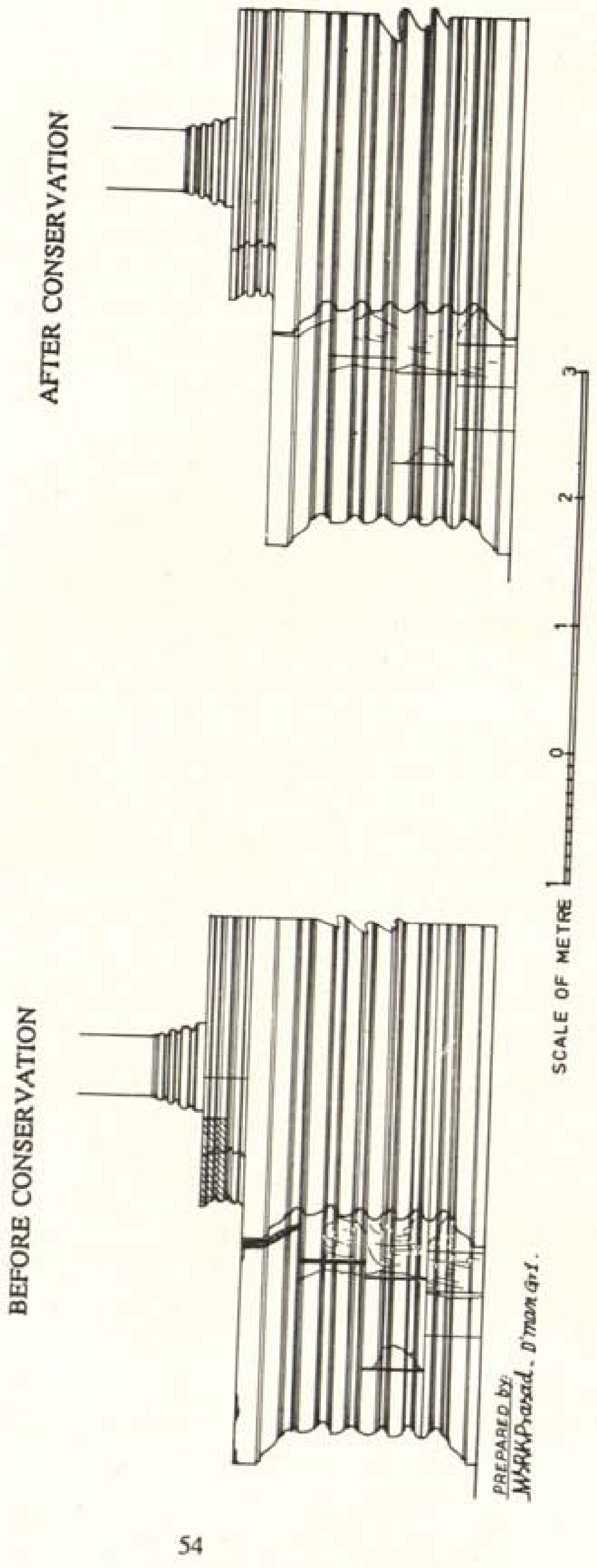


FIG. 14

northern portion was precariously overhanging. The flooring was also dislodged and one pillar was in bad condition and the other was missing. Fortunately, the collapsed architectural members of the superstructure were lying in a heap on the floor of the porch.

In the first instance suitable strong scaffolding was erected and then the precariously overhanging superstructure was supported from inside. Subsequently, the fallen eleven (11) architectural members were identified and shifted from the spot. The debris accumulated in the interior of the structure and also on the spot was cleared. Then the extant portion of the porch was dismantled and the members were systematically stacked. Altogether seventeen (17) members were dismantled.

After conserving the massive double plinth, stepped entrance etc., the plinth and flooring of the porch were dismantled and reconstructed as per the original. Altogether twenty-five (25) architectural members were dismantled and reset.

(e) Plinth and Stepped Entrance

The massive double plinth, stepped entrance with flanking balustrades and landings were in dilapidated condition due to dislodgement of their architectural members. These were taken up for conservation as a precautionary measure before taking up the reconstruction of the porch over the double plinth.

The dilapidated plinth portions and the balustrades were dismantled. After consolidating the core which had been badly damaged due to penetration of roots and percolation of rain water, and after reconditioning the flight of steps, the portions were reconstructed as per the original. Altogether one hundred and nine (109) architectural members were dismantled and reset in the process of conservation. Another three (3) members which were lying on the ground due to collapse of a portion were put back in their original positions in the structure.

However, it is unfortunate that the Northern Library as a whole could not be conserved due to the time factor. Some of the major items of work to be executed are : (i) reconstruction of the western porch after consolidating the existing pillars and casting a missing one; (ii) conservation of eastern entrance porch; (iii) resetting the dislodged *toranas;* and (iv) watertightening the roof.

7. ANTECHAMBER (CRUCIFORM GALLERY) BETWEEN SECOND AND THIRD ENCLOSURES

(a) Southern Stepped Entrance

The architectural members of the plinth and the steps had been dislodged from their original position due to heavy growth of vegetation. The dislodgement was so pronounced that it was not possible to conserve without dismantling and resetting. The members of the plinth, balustrade and steps were dismantled and after eradication of vegetational growth with roots from the core and plugging of the crevices and joints, the dismantled portions were reset (pl. LI). Altogether fifty (50) architectural members were dismantled and reset (fig. 13). Further, the structure was watertightened by grouting and pointing the joints.

ANGKOR VAT TEMPLE COMPLEX
SIEMREAP (CAMBODIA)

EASTERN ENTRANCE AT NORTHERN CORNER
OF SECOND ENCLOSURE (BEFORE CONSERVATION)

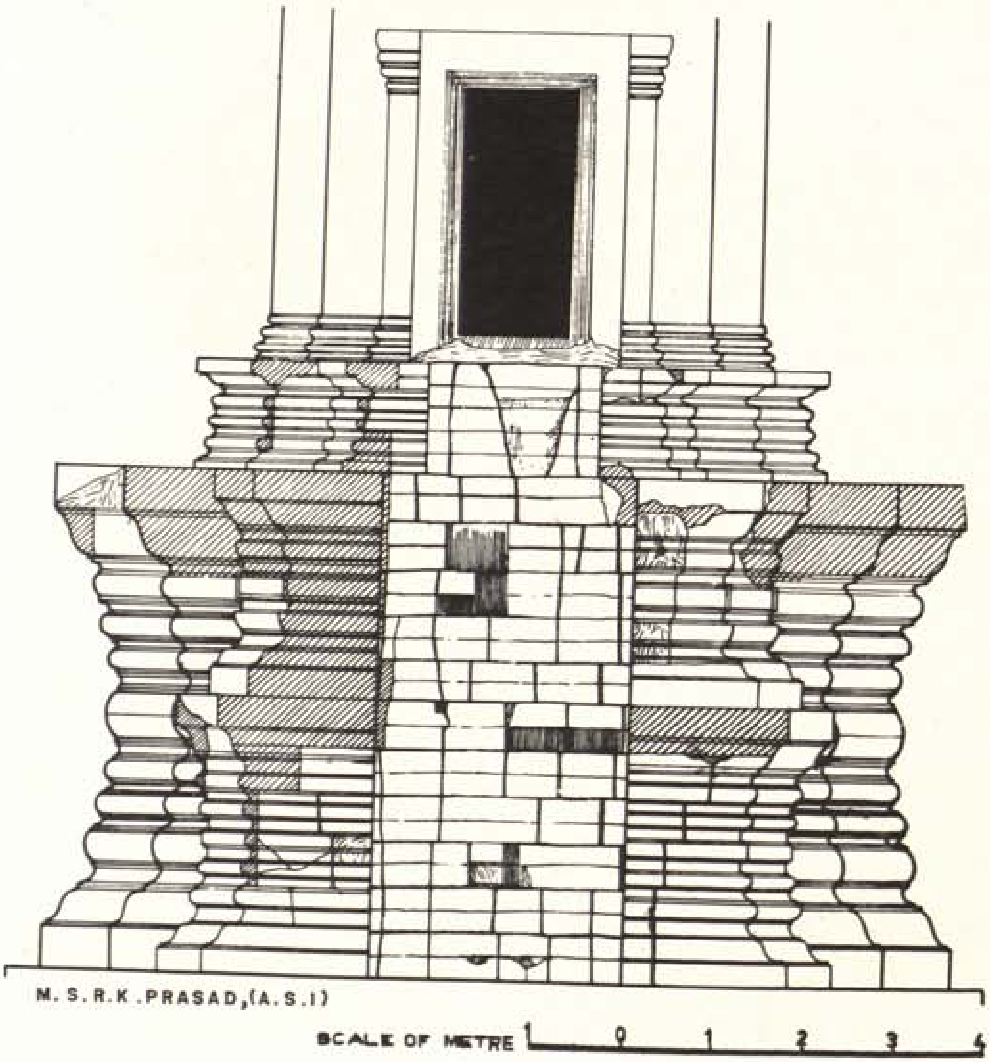


FIG. 15a

ANGKOR VAT TEMPLE COMPLEX

SIEMREAP (CAMBODIA)

EASTERN ENTRANCE AT NORTHERN CORNER OF SECOND ENCLOSURE (AFTER CONSERVATION)

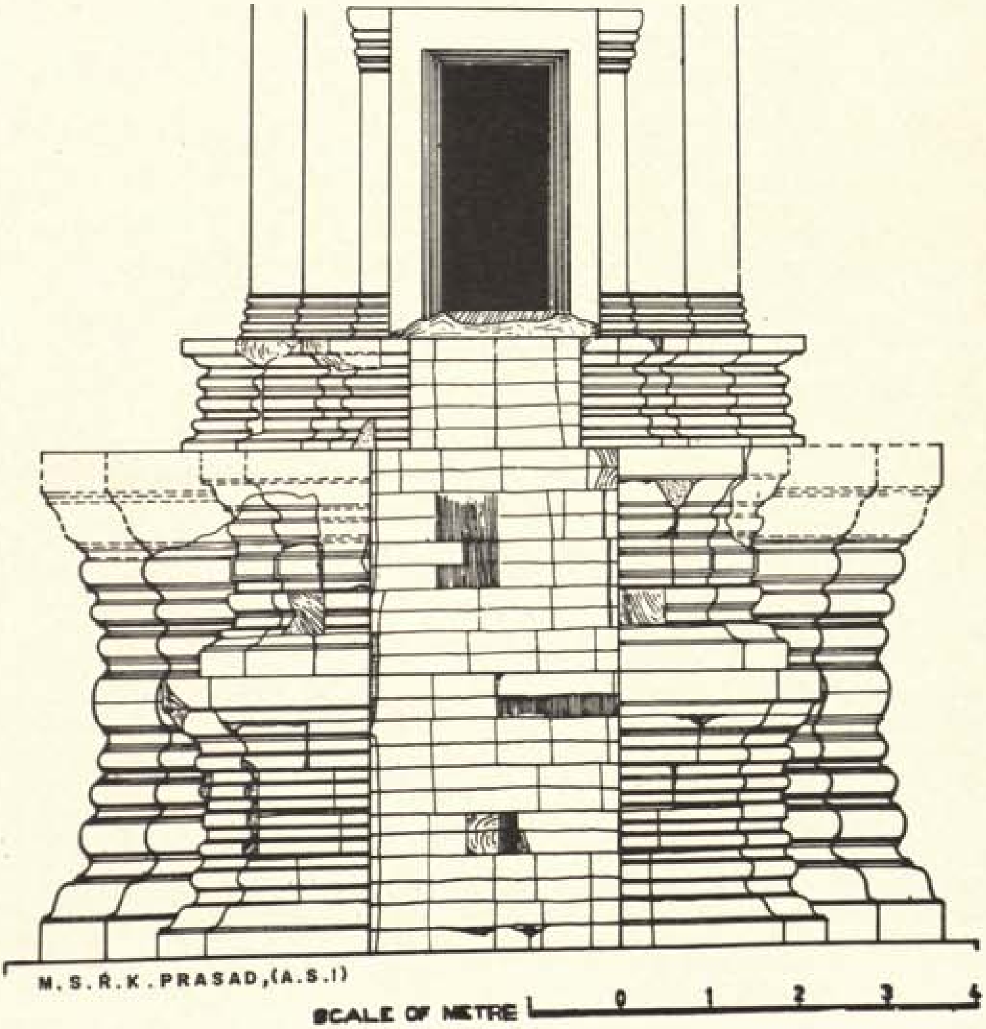


FIG. 15b

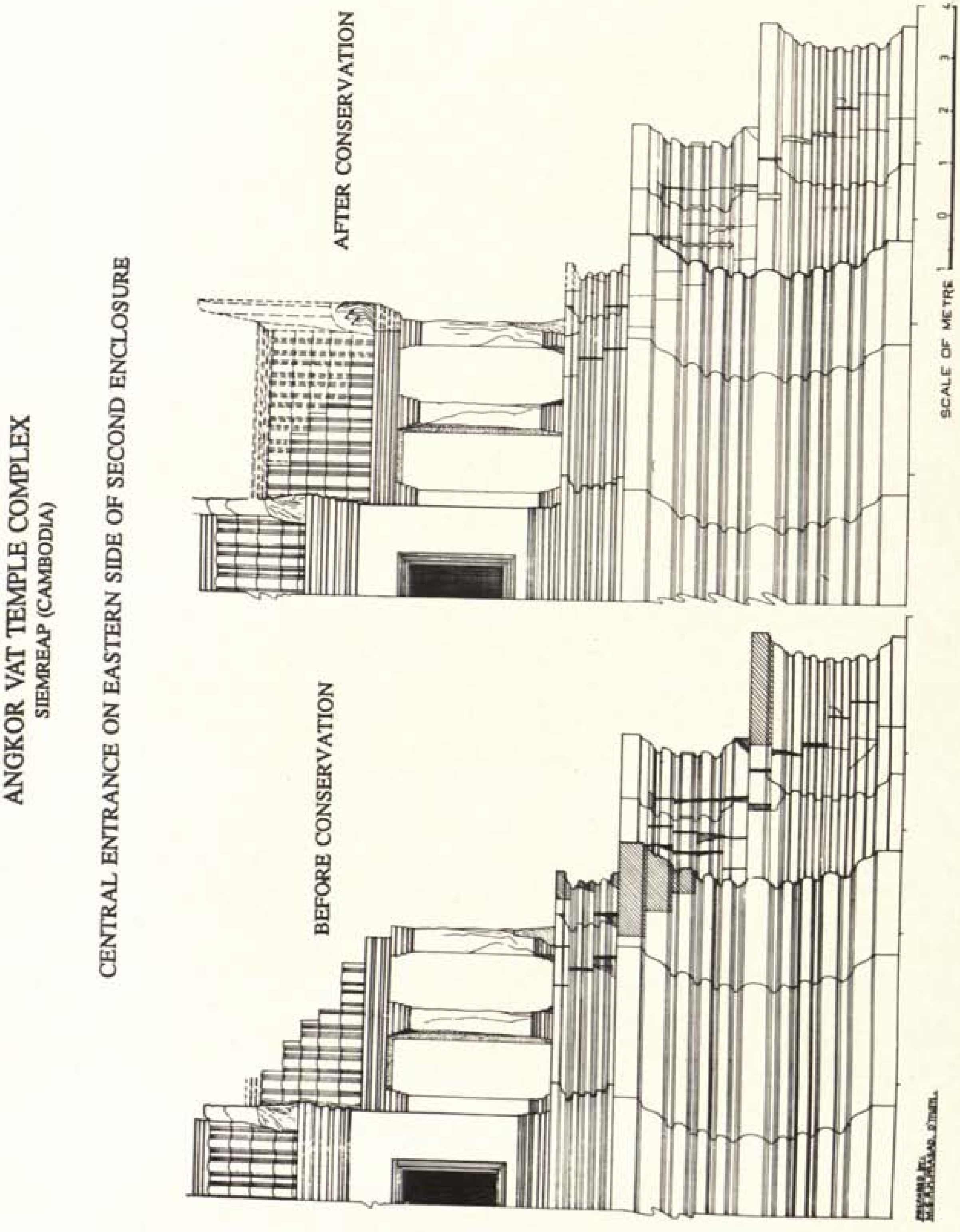

ANGKOR VAT TEMPLE COMPLEX
SIEMREAP (CAMBODIA)
CENTRAL ENTRANCE ON EASTERN SIDE OF SECOND ENCLOSURE
BEFORE CONSERVATION
AFTER CONSERVATION
SCALE OF METRE
1 0 1 2 3 4

FIG. 16

(b) Northern Stepped Entrance

This structure had suffered due to heavy growth of vegetation as in the case of other entrances. While conserving this structure twenty-two (22) architectural members had to be dismantled and reset as per the original (fig. 14), as members had been dislodged from their original positions.

(c) Interior

In this antechamber, cruciform in plan, almost all the pillars were in damaged condition and the members of the semi-vaulted roof were missing. Thus, the whole chamber was giving a dilapidated look. Therefore, the twenty-eight (28) damaged pillars were strengthened by providing concealed steel belts and mending wherever necessary. The missing members of the roof of the verandah were provided with RCC moulded ones to a length of 100 m. Further work could not be done due to shortage of time.

(d) Southern Gallery

In this gallery there was an accretionary platform recently built of laterite blocks and earth filling. This was not only ugly looking but also was a nuisance as the dust and dirt from this platform was spreading all over. It was also an obstacle to the easy movement of the visitors. This was probably constructed to exhibit some of the sculptures. However, the Cambodian authorities had requested the Indian team to remove this platform in the 1991-92 season's work. But it could not be removed due to shortage of time. Therefore, this work was taken up in 1992-93 season. While removing this platform, measuring 27·50 x 2·90 x 0·60 m it was found that a number of broken architectural members and sculptures were also used in the construction. The good pieces which are worth keeping were collected and which could be exhibited were exhibited on suitable pedestals and small platforms (pl. LII). This gallery now looks pleasant with its exposed original floor and the idols numbering twenty-three (23) exhibited in proper manner.

8. SECOND ENCLOSURE

(a) Eastern Entrance at North Corner

This entrance with flight of steps flanked by massive balustrades representing double plinth of the enclosure, was in a dilapidated condition, due to very heavy growth of vegetation. Some of the stone members had been dislodged and some had fallen down and joints in the masonry had widened. Altogether, forty-nine (49) members which had been dislodged from their original positions were reset very carefully using horizontal jacks and man power without causing any damage to the members. Further, fourteen (14) architectural members were retrieved from the stacked lot, and also by digging the area alround. These members were also reset in their positions in the balustrade and the landings (pls. LIII-LIV). The conservation of this entrance was completed in all respect including watertightening by grouting and pointing (fig. 15).

(b) Eastern Central Entrance

This entrance, similar in consruction had same conservation problem as that of the above

ANGKOR VAT TEMPLE COMPLEX
SIEMREAP (CAMBODIA)

SOUTHERN ENTRANCE AT EASTERN CORNER
OF SECOND ENCLOSURE (BEFORE CONSERVATION)

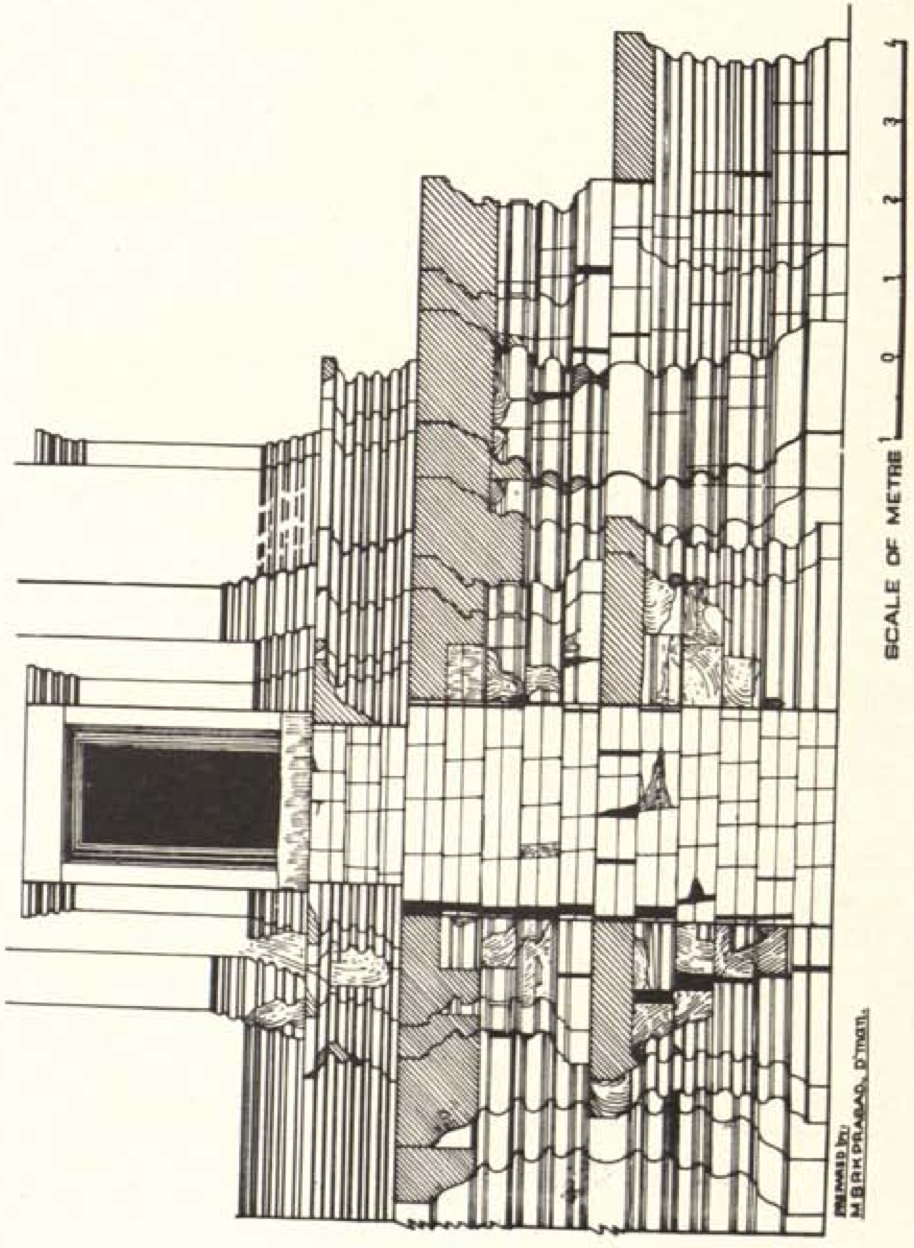


FIG. 17a

ANGKOR VAT TEMPLE COMPLEX
SIEMREAP (CAMBODIA)

SOUTHERN ENTRANCE AT EASTERN CORNER
OF SECOND ENCLOSURE (AFTER CONSERVATION)

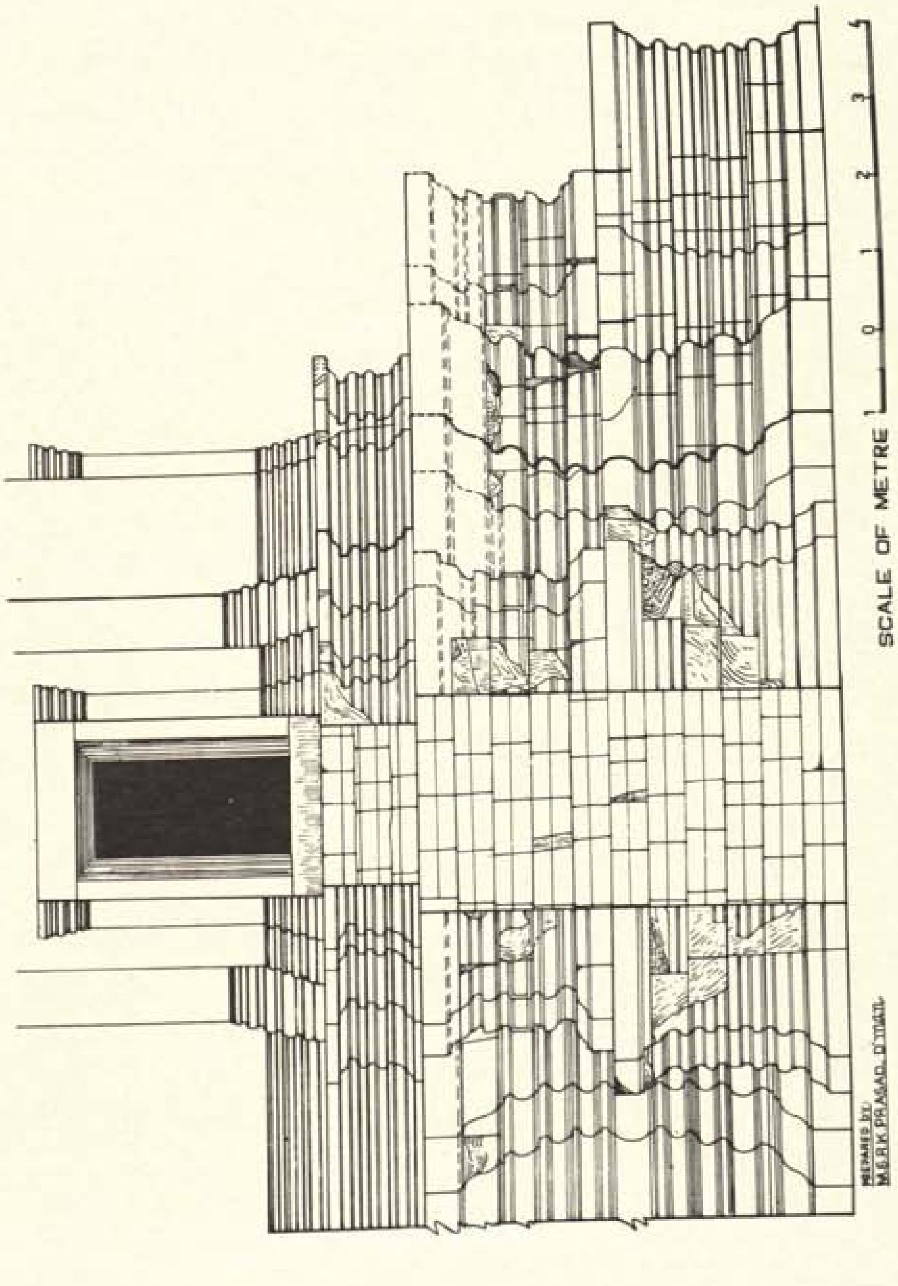


FIG. 17b

ANGKOR VAT TEMPLE COMPLEX
SIEMREAP (CAMBODIA)

SOUTHERN CENTRAL ENTRANCE OF
SECOND ENCLOSURE (BEFORE CONSERVATION)

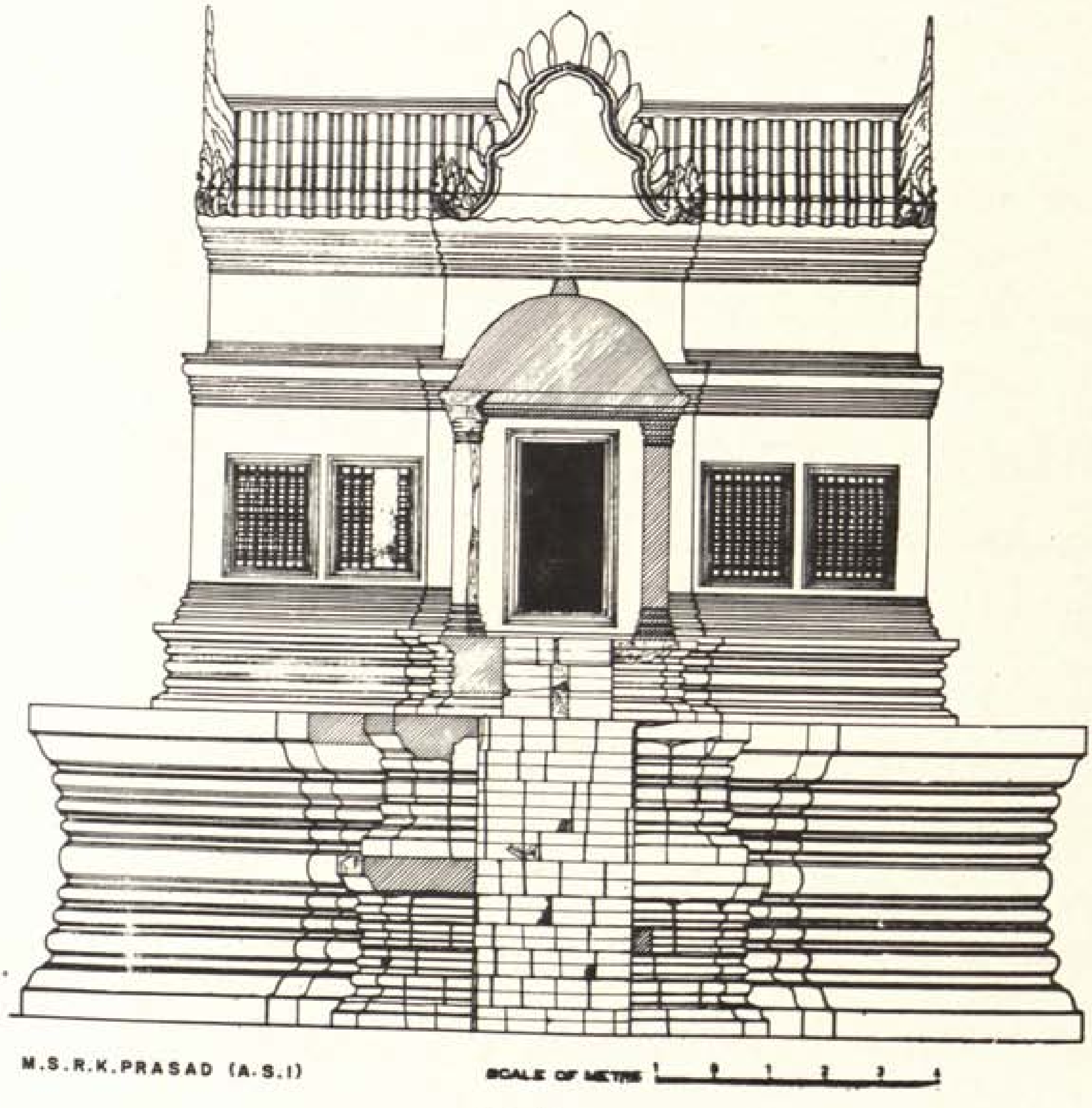


FIG. 18a

ANGKOR VAT TEMPLE COMPLEX
SIEMREAP (CAMBODIA)

SOUTHERN CENTRAL ENTRANCE OF SECOND ENCLOSURE (AFTER CONSERVATION)

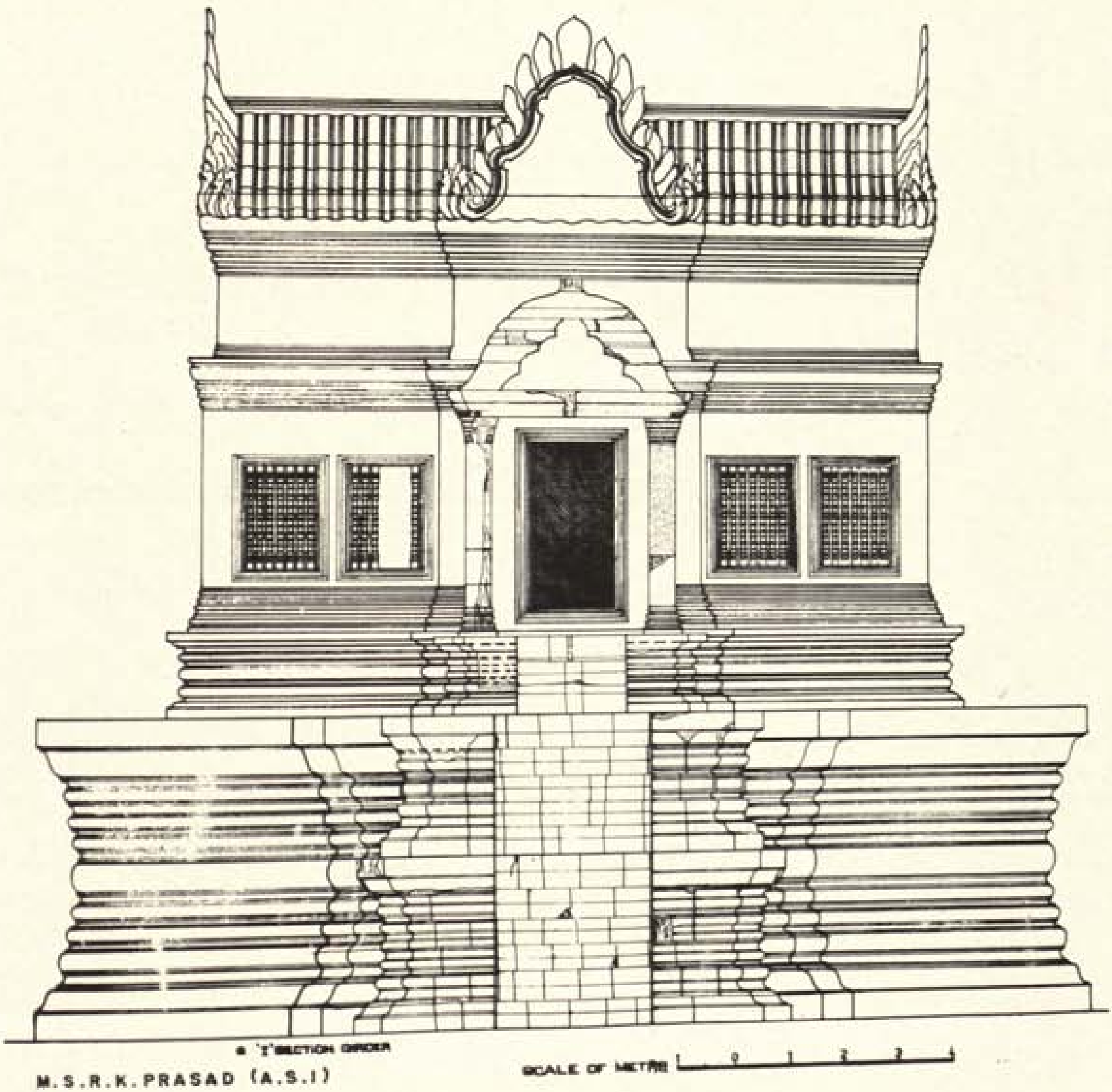


FIG. 18b

ANGKOR VAT TEMPLE COMPLEX
SIEMREAP (CAMBODIA)

WESTERN ENTRANCE AT SOUTHERN CORNER
OF SECOND ENCLOSURE (BEFORE CONSERVATION)

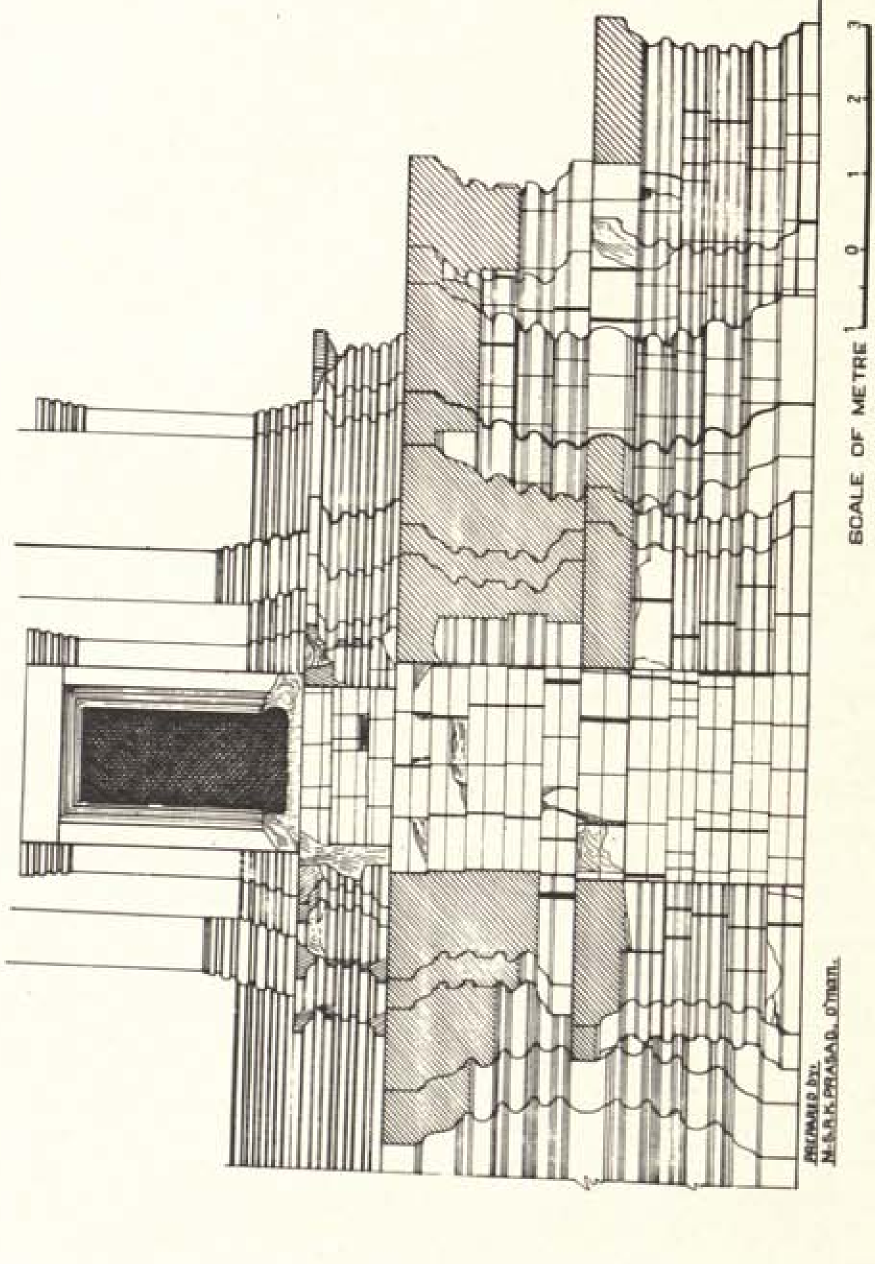


Fig. 19a

ANGKOR VAT TEMPLE COMPLEX
SIEMREAP (CAMBODIA)

WESTERN ENTRANCE AT SOUTHERN CORNER
OF SECOND ENCLOSURE (AFTER CONSERVATION)

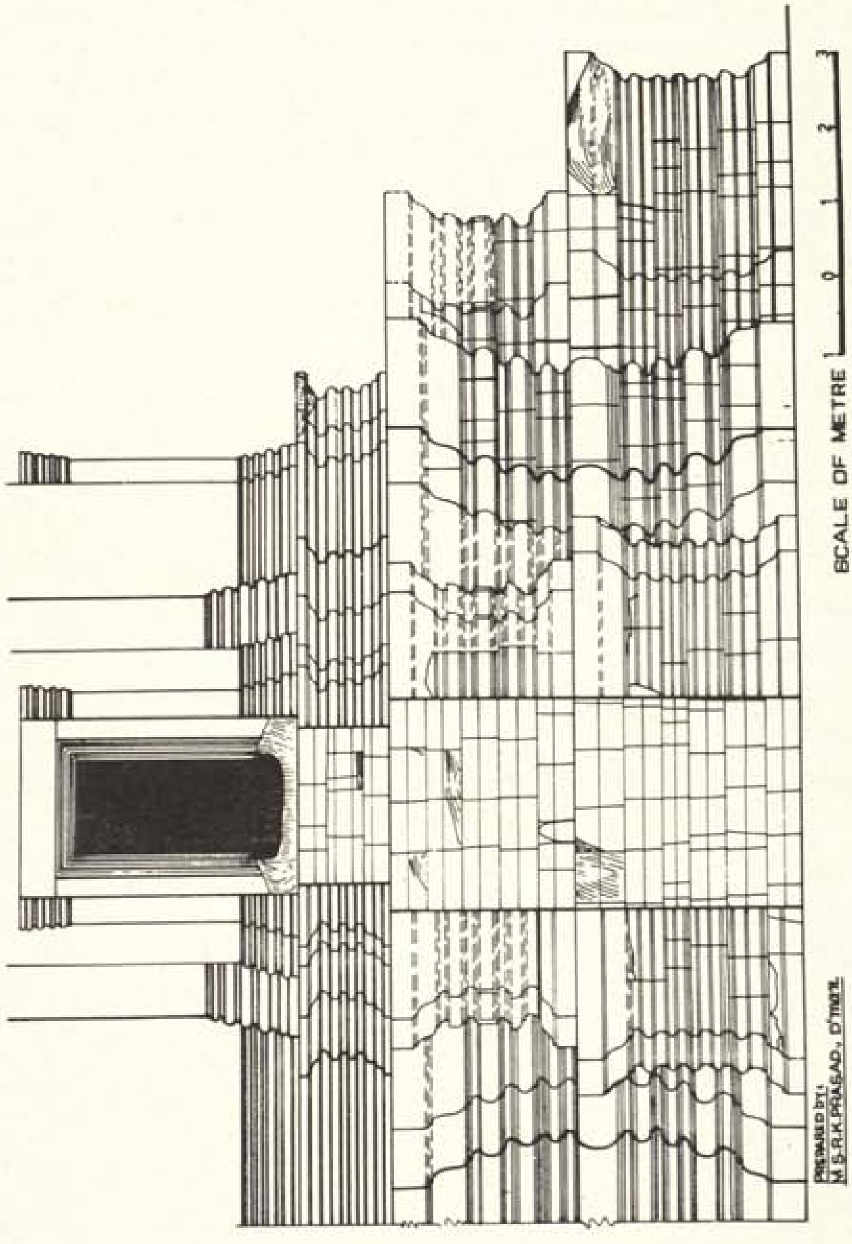


FIG. 19b

mentioned one. All the dislodged twenty-one (21) stone members were moved into their proper positions by using horizontal jacks and by human efforts. Another nine (9) members which had fallen down from their original positions were hauled up and fixed in their positions (pl. LV). The structure (fig. 16) was waterightened by filling up the gaps and crevices and grouting and pointing of the joints in the masonry.

(c) Eastern Entrance at South Corner

As the constructional method and the conservation problems were same as those of the above mentioned entrances of this enclosure, the method of conservation was also the same. However, forty-five (45) dislodged stone members were refixed in their proper position. In addition, three (3) large architectural members weighing nearly four tonnes each which had fallen down from their positions were lifted up and fixed in their positions. All the cavities, gaps and joints were grouted and pointed suitably, so that there will not be any penetration of rain water and vegetational growth over the structure.

(d) Southern Entrance at East Corner

As in the case of other entrances of this enclosure, this one had also suffered very heavily due to vegetational growth. However, in this case, it was not possible to reset the dislodged stone members without dismantling, as the dislodgement was very severe. Therefore, some of the portions of the balustrades were dismantled and reset. Thirty-seven (37) architectural members were dismantled and reset, and another, thirty-eight (38) members which had been displaced were pushed back to their original position. In addition, two members, weighing nearly four tonnes each were hoisted back to their original positions in the balustrades (pl. LVI). The structure thus conserved was watertightened by grouting and pointing (fig. 17).

(e) Southern Central Entrance

It can be recalled here that the porch of this entrance had collapsed long ago, and the fallen members were in a heap. Due to this, the entrance was inaccessible to the visitors. In addition, it was an eye-sore as the debris had not been cleared from the site.

As a preliminary step, all the architectural members were identified, removed and neatly stacked after proper documentation. Then the site was cleared of debris. However, while shifting the architectural members, it was noticed that some of them like pillars, beams, roof stones had been damaged. Among the broken members, one of the pillar which was in two pieces was thoroughly mended and made fit for reuse. Another pillar was not in a condition to be mended fully for reusing it. Therefore, the major portion of the original pillar which was in good condition was taken, and the missing portion was cast in RCC, and thus made fit for reuse. In addition, the front and side beams which had broken into two and three pieces respectively, were also mended and strengthened by providing concealed I-section girders. Besides, eight (8) roof members which had broken were also suitably mended.

After reconditioning the flooring which had been crushed and dislodged due to the collapsing of the heavy superstructure over it, the four pillars including the mended ones were erected and then the beams were hoisted to their proper position. Altogether forty-six (46) architectural members, retrieved from the debris, were reused in the reconstruction of this porch (pl. LVII). It can be noted here that hauling up and resetting the architectural members at a height between 6·2 and 13·2 m from the ground level, only with the help of chain pulley blocks and human effort, could be achieved with certain amount of difficulty.

The flight of steps flanked by massive balustrades of this entrance also had the same conservation problems as those of the above mentioned one. The structure was conserved (fig. 18) in all respect including resetting of the dislodged members, lifting and fixing of the fallen members, grouting and pointing. Altogether, sixteen (16) members were reset in their proper position.

(f) Southern Entrance at West Corner

As in the case of other stepped entrances of this enclosure, this was also conserved in the same manner. While conserving flight of steps and balustrades thirty-one (31) stone members which had been dislodged were reset in their proper position (pl. LVIII). In addition, two (2) members which had fallen down were put back in their places. Further, all the joints and gaps were thoroughly grouted and pointed.

(g) Western Entrance at South Corner

In the first instance, before taking up the conservation work, the area between the two entrances had to be cleared as it was strewned with stone members which did not belong to either of the two entrances. While clearing, thirty-four (34) architectural members, probably belonging to the south-west corner tower and southern library, were removed and stacked at a distance from the entrance.

In this structure(fig. 19), eight (8) architectural members were dismantled and reset, and another twenty-seven (27) stones which had been displaced were reset in their proper position (pl. LIX). Only one stone member which had fallen down was put back in its original place. Then the structure was watertightened.

(h) Western and Northern Stepped Entrances

Western Stepped Entrance — This massive structure had suffered due to thick growth of vegetation and dislodgement of architectural members. Some of the portions had to be dismantled and reset after removing the deep rooted vegetation and consolidating the core. While conserving sixty-five (65) members of the plinth, balustrades and steps were dismantled and reset. In addition, two (2) stones of balustrades weighing nearly four tonnes each which had fallen down were hauled up and fixed in their original positions in the structure (pl. LX). Then the whole structure (fig. 20) was watertightened.

Northern Stepped Entrance—This structure was in no way in a better condition than the other entrances of the second enclosure. As in the case of the other entrances, the affected portions of the

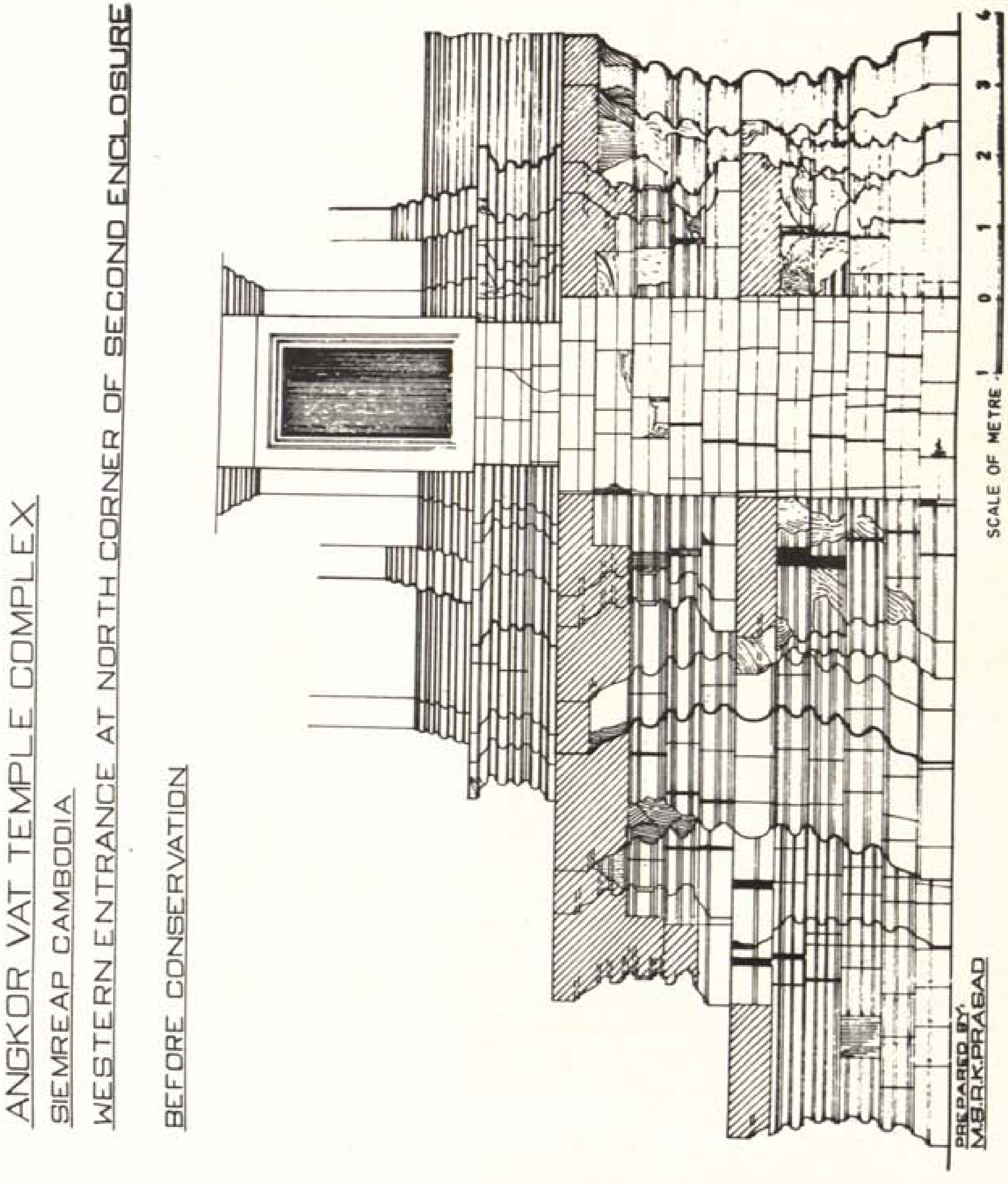

ANGKOR VAT TEMPLE COMPLEX
SIEMREAP CAMBODIA
WESTERN ENTRANCE AT NORTH CORNER OF SECOND ENCLOSURE
BEFORE CONSERVATION
PREPARED BY,
M.B.R.K.PRASAD
SCALE OF METRE
1 0 1 2 3 4

FIG. 20 a

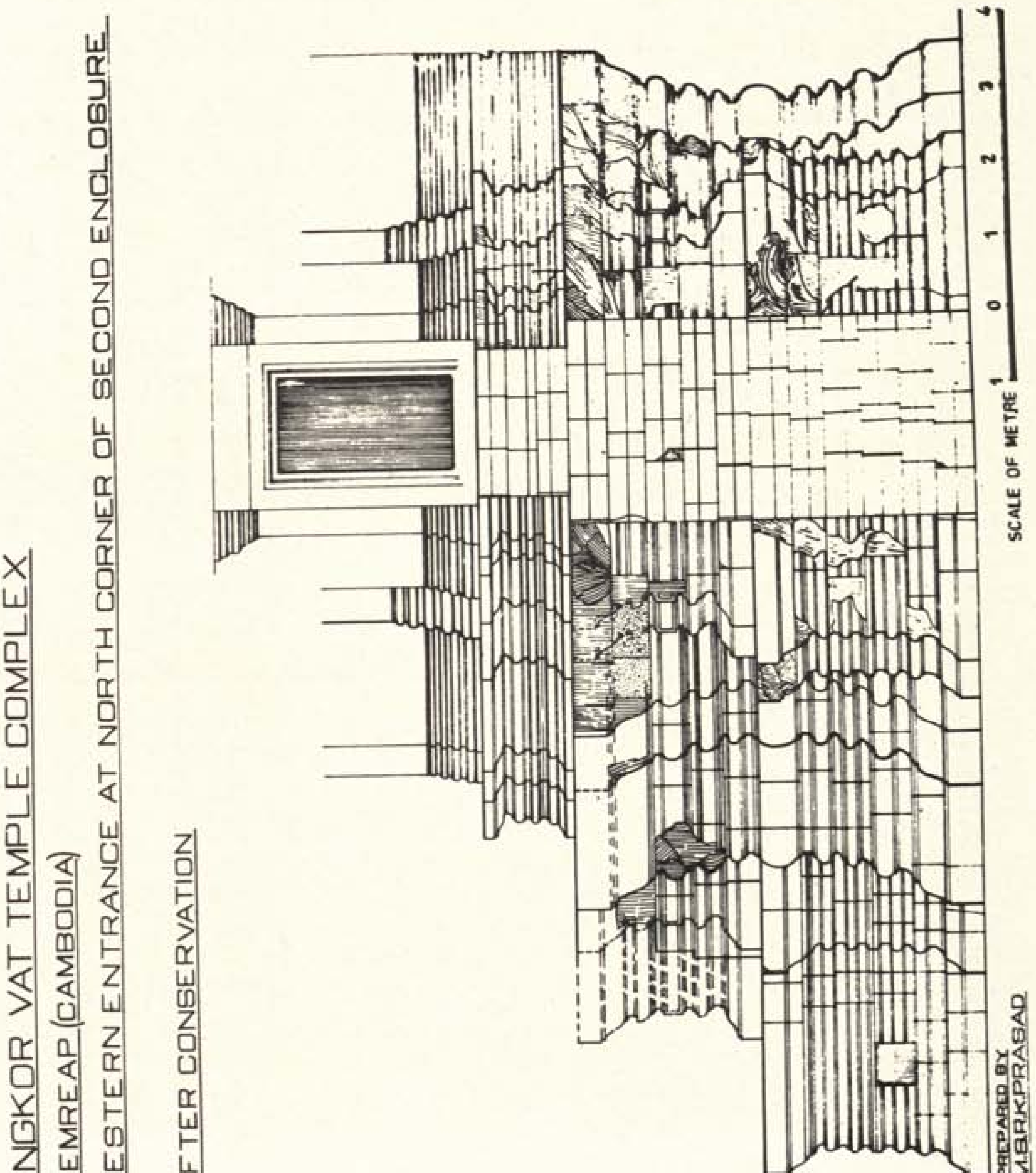

ANGKOR VAT TEMPLE COMPLEX
SIEMREAP (CAMBODIA)
WESTERN ENTRANCE AT NORTH CORNER OF SECOND ENCLOSURE
AFTER CONSERVATION
SCALE OF METRE
PREPARED BY
M.B.R.K.PRASAD

FIG. 20b

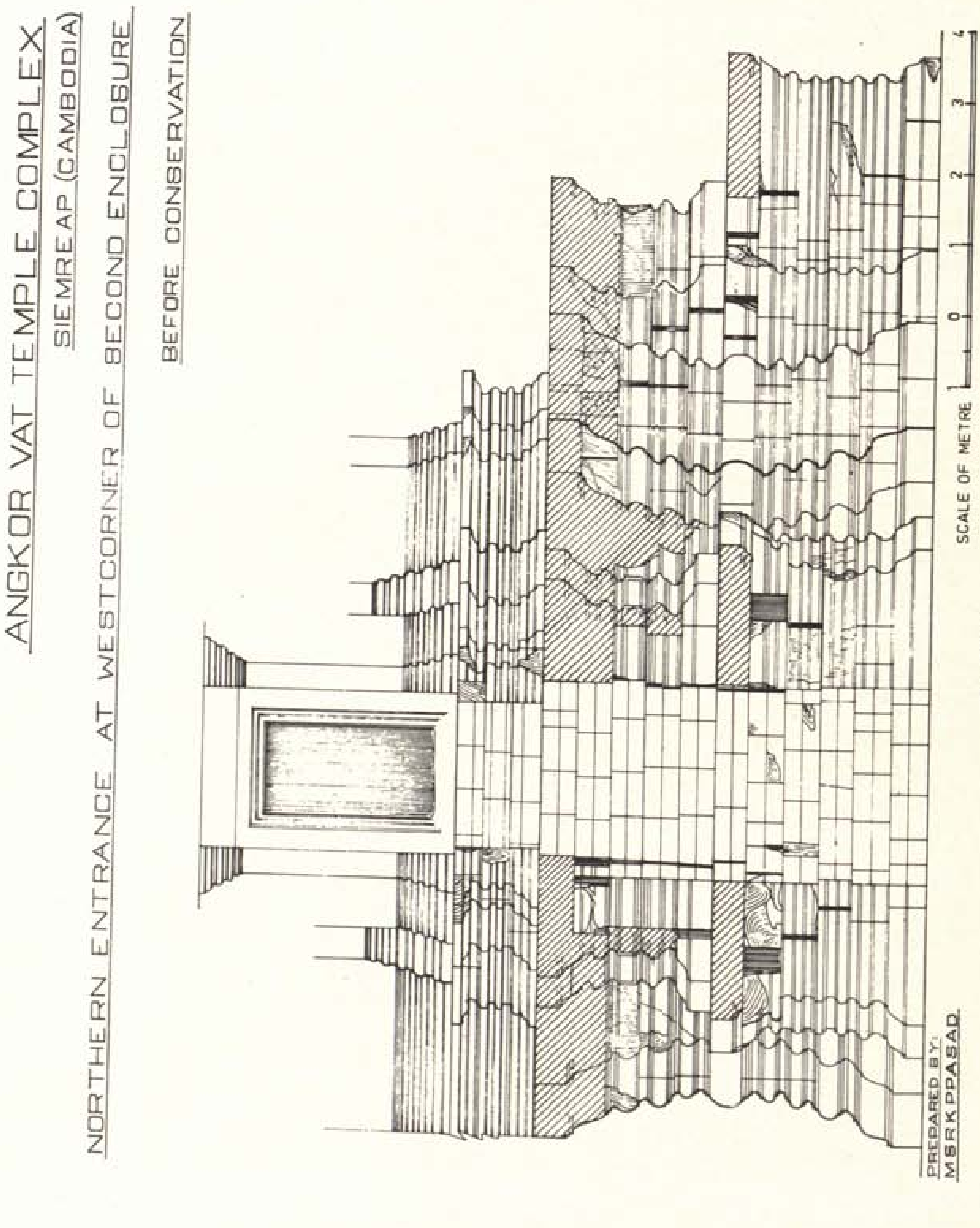

ANGKOR VAT TEMPLE COMPLEX
SIEMREAP (CAMBODIA)
NORTHERN ENTRANCE AT WESTCORNER OF SECOND ENCLOSURE
BEFORE CONSERVATION
PREPARED BY:
MSRKPPASAD
SCALE OF METRE
1 0 1 2 3 4

Fig. 21a

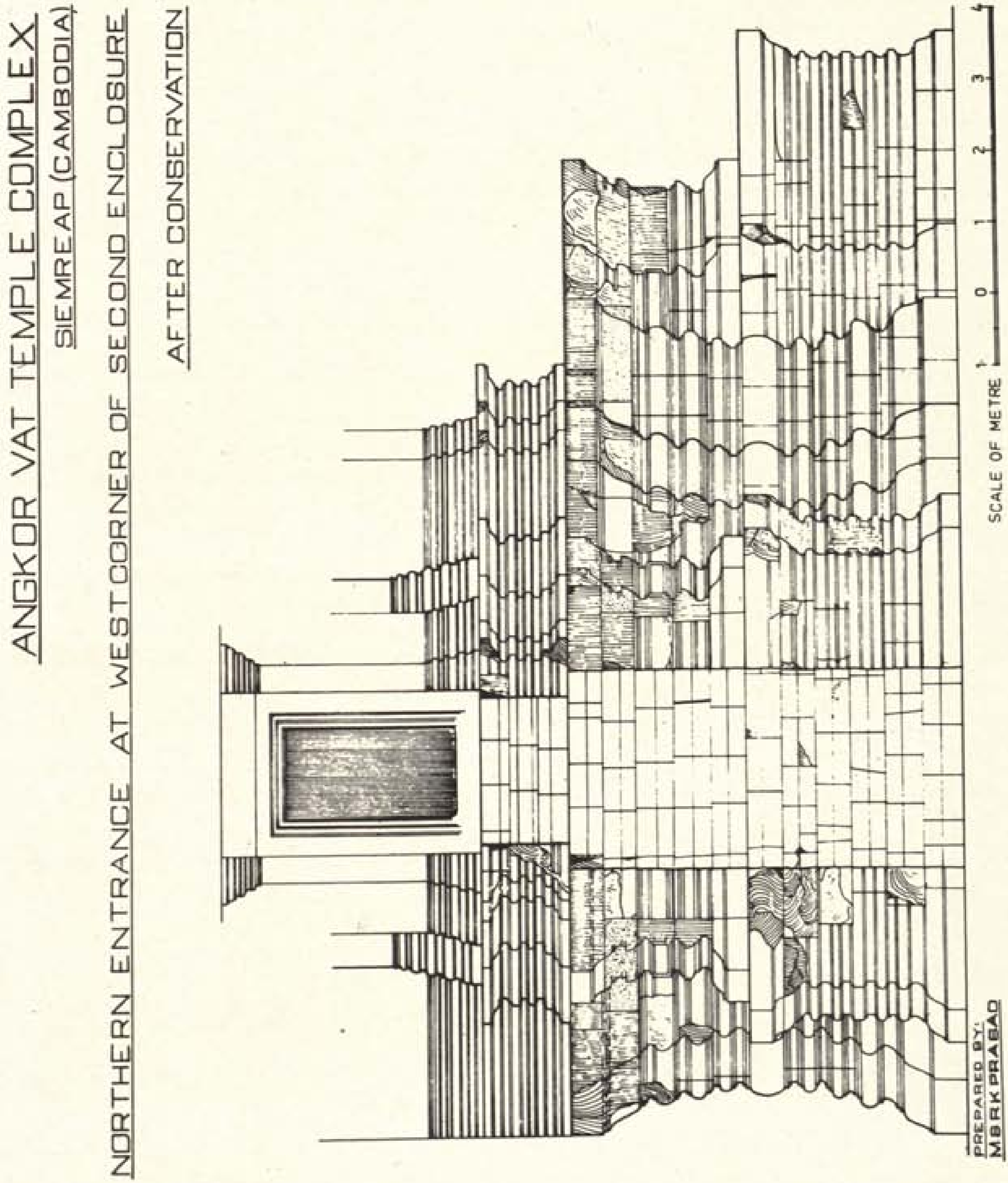

ANGKOR VAT TEMPLE COMPLEX
SIEMREAP (CAMBODIA)
NORTHERN ENTRANCE AT WEST CORNER OF SECOND ENCLOSURE
AFTER CONSERVATION
SCALE OF METRE
1 0 1 2 3 4
PREPARED BY:
MBRK PRASAD

Fig. 21b

plinth, balustrades and steps were dismantled and reconstructed as per the original after consolidating the core. While conserving, seventy-four (74) architectural members were dismantled and reset. Another four (4) members which were lying on the ground were identified and hauled up and fixed in their original positions in the structure (pl. LXI). Then the structure was thoroughly watertightened (fig. 21).

(i) Northern Central Entrance

This massive imposing structure was in dilapidated condition due to dislodgement of architectural members of plinth, stepped entrance with flanking balustrades, landings and the porch itself. In fact the pillars of the porch had not only weathered and developed vertical cracks, but had also gone out of plumb. Due to this, the extra superstructure including three beams and four roof members was precariously overhanging. Therefore, as a precautionary measure the members of the superstructure were dismantled and stacked inside the pavilion, as it would be easy to lift and fix the members while conserving.

Then, the western balustrades and a portion of the plinth were dismantled. After consolidating the core and resetting the dislodged steps, the dismantled portions were reset as per the original. Subsequently, the eastern balustrade upto first landing was also dismantled and reset after consolidating the core. Altogether, fifty-five (55) architectural members were dismantled and reset, and another fourteen (14) members were reset without dismantling, but with the help of horizontal jacks and by human effort. In addition, three (3) huge architectural members which were lying on the ground were identified and fixed in their original positions in the structure. Then the whole structure (fig. 22) was watertightened.

Unfortunately, the conservation work of the porch couid not be completed due to shortage of time. Remaining items of work to be executed are : (i) second landing of the eastern balustrade; (ii) consolidating of the pillars and casting of one missing pillar; (iii) reconstruction of the dismantled extant superstructure; and (iv) identifying and fixing of the members lying on the ground.

(j) North-west Exterior Corner

In this portion of the second enclosure itself, some of the stones were overhanging precariously and some had already fallen down. While conserving the dislodged portion six (6) architectural members were reset in their positions and another three (3) fallen members were hauled up and fixed in their original positions in the structure.

(k) South-west Corner Tower

The vegetation had grown very freely over this structure, and the roots had penetrated through the joints in the masonry of the walls and were hanging inside the structure. The removal of the vegetational growth was itself a great task. After clearing the vegetational growth thoroughly by raking the joints, thirty-eight (38) dislodged stone members were reset in their proper position. And then, grouting and pointing was done. Extreme care was taken to fill up all the crevices and holes

as well as joints in the masonry, so that no vegetation grows once again over the structure. The opening at the top of the tower due to missing of the members, through which rain water was pouring down into the structure was sealed by providing RÇC slabs. The weathered architectural members, especially the ones supporting the members with cantilever action were strengthened by providing concealed steel rods.

(l) North-west Corner Tower

This tower had also suffered due to vegetational growth and due to opening at the top which allowed rain water directly into the structure. Altogether twenty-eight (28) dislodged stone members were reset. Top opening was sealed by RCC slabs. Crevices and gaps were filled up. The structure was watertightened by grouting and pointing.

(m) North-east Corner Tower

The conservation problems in this structure were same as in the above mentioned towers. The opening at the top was sealed with RCC slabs. Internally, all the gaps and joints were filled up and pointed. One of the beams which had almost completely weathered was strengthened by providing I-section girders, and the door frames were strengthened by providing concealed steel rods. Two pilasters which were very badly weathered were strengthened by providing concealed rods.

Further, on the exterior of the tower, twenty-six (26) dislodged architectural members were reset in their proper position. In addition, seven (7) architectural members of the decorative *torana* on the west, which had been dismantled sometime before 1986 and stacked on the roof of the gallery attached, were identified and reset in their proper position. Thereafter, all the crevices and joints were thoroughly grouted and pointed. .Thus, the whole structure had not only been strengthened, but also watertightened, so that no vegetation grows over the structure in future.

(n) South-east Corner Tower

The vegetational growth over this structure had played havoc in dislodging the stone members of the top courses of the extant portion. Further, as the topmost portion of this tower was missing, the rain-water had free entry into the structure, and had caused weathering of the interior surface to the tower and walls. All the dislodged stone members, thirty (30) in number, were reset, and the top opening was sealed by providing RCC slab. Further, all the crevices and joints were grouted and pointed so that no vegetation grows over the structure.

(o) Galleries

The roof of all the galleries on four sides was thoroughly watertightened by grouting and pointing the joints in masonry of vaulted as well semi-vaulted roof.

9. FIRST ENCLOSURE

(a) Towers

All the five towers including the central one were in precarious condition. It was found that the towers had been damaged due to heavy vegetational growth. Even fairly big architectural members,

ANGKOR VAT TEMPLE COMPLEX
SIEMREAP (CAMBODIA)

NORTHERN CENTRAL ENTRANCE PORCH OF SECOND ENCLOSURE
(BEFORE CONSERVATION)

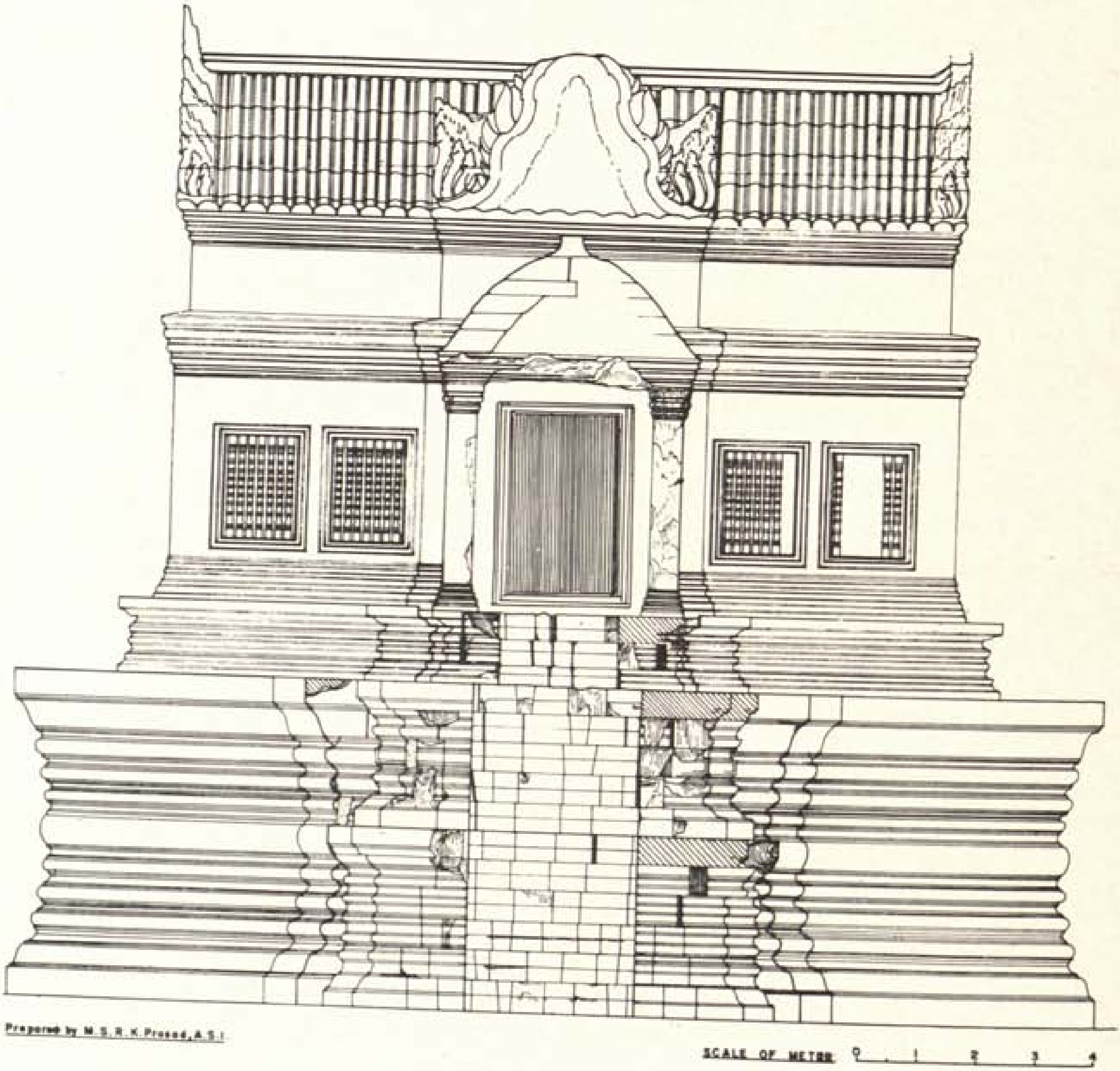


FIG. 22a

ANGKOR VAT TEMPLE COMPLEX
SIEMREAP (CAMBODIA)

NORTHERN CENTRAL ENTRANCE PORCH OF SECOND ENCLOSURE
(AFTER CONSERVATION)

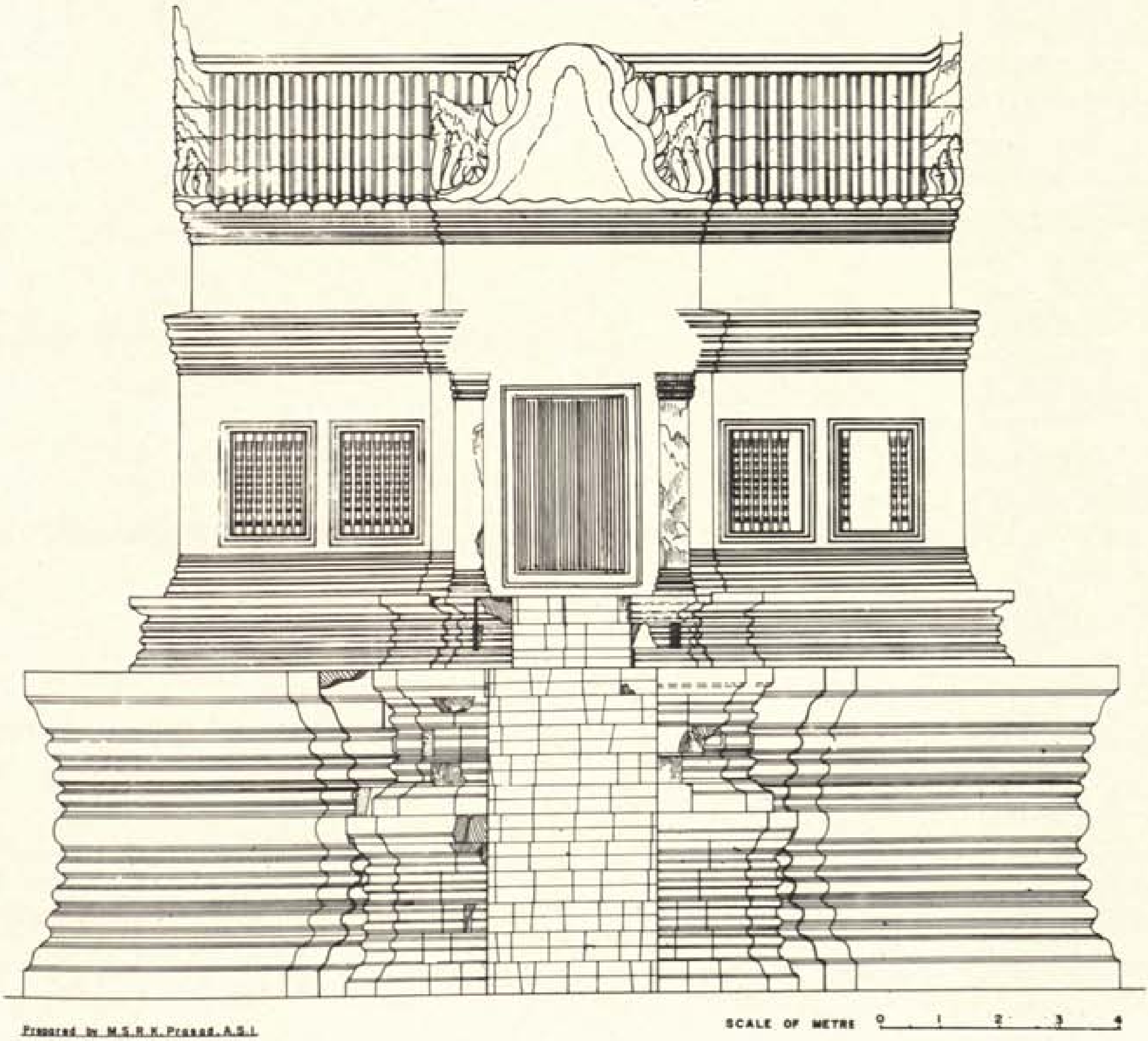


Fig. 22b

let alone smaller ones, had been dislodged and were overhanging precariously. However, most concerning was that the supporting stones of the members with cantilever action were weathering fast. Crevices and gaps had formed which allowed rain water to flow into the fabric of the structure and damage the stones. The architecural members of the tower were being pulverised due to water action. The leakage in the towers was so much that all the rain water was flowing into the structure. The vegetation was growing freely over them. The birds and bats had made their nests in the crevices and gaps. Therefore, the conservation of the towers was of high priority.

But, it was not an easy task to achieve. It may be remembered that all the towers including central tower are 36 m in height from their working level. Therefore, erecting suitable scaffolding and preparing platforms at different-levels for the easy movement of the workers to handle fairly big dislodged architectural members to put them in their proper positions was in itself a difficult task.

However, the conservation work was carried out with success. The dislodged and loose architectural members were fixed in their proper positions (pls. LXII-LXVI). All the large crevices and gaps were filled up with cement concrete. The joints were grouted and pointed. The degenerated stones, especially the ones which were supporting the architectural members with cantilever action were strengthened suitably providing concealed steel rods. Thus, all the five towers have been consolidated and strengthened.

(b) Galleries

The roof of all the galleries on four sides of the enclosure and four galleries radiating from the main shrine was thoroughly watertightened by grouting and pointing the joints in the masonry of vaulted as well as semi-vaulted roof. However, before watertightening more than one hundred and thirty-five (135) dislodged architectural members of the roof and the pediments *(toranas)* were reset in their original positions.

10. RAILING BETWEEN THIRD AND FOURTH ENCLOSURE

(a) Stepped entrance at north-west Corner

This stepped entrance had been dismantled and was partially reconstructed by the French team before 1970. However, it is not known why this was dismantled in the first instance. But one can only imagine the reason for dismantling. Possibly, the whole railing all around was in dilapidated condition due to heavy growth of vegetation. Therefore, with a view to reconstructing it, the whole railing must have been dismantled. Then the reconstruction must have been started from different points with the intention of completing the work quickly. But, unfortunately, errors crept in. Therefore, the ends of the two opposite works could not meet. This situation can be seen even today at several places all around. This was one such place, and they had to abandon the work.

Be that as it may, due to exposing for a long period of time, the core was deteriorating and the vegetation was growing freely. Therefore, the structure had to be further dismantled by our team. The core was consolidated by replacing eleven (11) damaged laterite blocks with new ones and by removing the vegetation and grouting the crevices and holes. Then, the structure was reconstructed

rectifying the errors as far as possible. In all forty-eight (48) architectural members including eleven (11) members dismantled earlier were reset as far as possible in their original positions (pl. LXVII). The structure was waterightened by grouting and pointing.

(b) South-east Corner

As in the case of the above one, here also some portion had been dismantled. However, the architectural members were lying on the site. While reconstructing, it was found that the ends were not meeting due to the reason mentioned earlier. But, the reconstruction was completed by using eight (8) members, after rectifying the error committed earlier.

11. PROVIDING EXPANDED WELDED MESH

Generally, in a simple monument the entry of bats and birds is arrested by closing all the entry points with welded mesh, and naturally, the earlier thought was also the same. However, a cursory look at this monument of such magnitude is quite enough to know that it is not possible to provide welded mesh to all the openings, as there are open verandahs alround the enclosures with too many entrances, and even if it is provided, it would be detrimental to the aesthetic beauty of the monument. Therefore, the idea of providing welded mesh to the openings was out of question. Instead, it was decided to provided welded mesh horizontally at a particular height in places where there is possibility of bats and birds making their nests. On experimental basis, first enclosure was taken up. Here, the welded mesh was fixed at a particular height where the wall and the spring-level of vaulted roof meet. Thus, the enclosure, tower, axial verandahs and *garbhagrihas,* covering an area of more than 500 sq. m have been provided with welded mesh (pl. LXVIII). It is needless to say that this method has proved itself to be very successful and is not in any way distracting the aesthetic value of the monument.

Likewise, in the second enclosure, western and northern galleries covering an area of 1,400 sq. m were provided with welded mesh. But the work could not be continued in other galleries of the second enclosure and other two enclosures due to shortage of time.

CHAPTER IV

CHEMICAL PRESERVATION

1. DECAY OF BUILDING MATERIALS

PHYSICAL DECAY—It is needless to stress that before taking up any chemical cleaning and preservation work in a monument, it is absolutely necessary to analyse chemical and physical properties of the building materials and the causes of decay. Thereafter, on the basis of the results of this study, suitable chemical conservation should be taken up. In addition, data on atmospheric conditions, temperature, humidity, rock temperature, rock moisture, rainfall, etc., are also absolutely necessary, as they contribute to the deterioration of the building materials.

This magnificent monument, Angkor Vat, built of sandstone blocks was subjected to a detailed study in all respects before taking it up for chemical conservation and preservation. For example, nine stone samples were taken from nine different parts of the monument. Petrological study was carried out by the Geological Survey of India, Southern Region, Hyderabad. The study showed that medium-grained sandstone of different hews, but dominating one being grey colour, may be identified as Wacke. However, fine grained variety has also been used in the construction, especialy in the construction of the walls of the galleries of the third enclosure, interior surface of which have been utilized for carving post-construction bas-reliefs representing incidents from the great Indian epics like the *Mahabharata* and the *Ramayana* as well as mythological and historical episodes. The sandstone, possibly brought from the quarries in the Mount Kulen, nearly 45 km from the temple complex, is a moderately sorted rock with matrix ranging from 25 to 30 percent. The constituents of the fabric are quartz (25 to 40 percent),feldspar (25 to 30 percent) and rock-fragments (5 to 15 percent). Quartz-mica, schist, chert, quarzite etc., are the constituents of the rock-fragments. In addition, the matrix consists of mica and chlorite alongwith a few grains of calcite. Interestingly, zircon, sphene, epidote, tourmaline, spatite and garnet are other contents in various proportions.

Needless to say that Angkor Vat being in the tropical region, the study of interaction of climatic variations is very essential. The studies showed that though the area is in tropical zone the climate is moderate due to rich forest growth. Generally, April is the hottest month and the temperature rises to 36°C. The relative humidity (recorded from March to June) is uniformly high, the average RH being 75 percent, but on some days it would be as high as 92 percent.

The study of surface temperature of the building material (sandstone) carried out a twenty selected places in the monument showed that by 3 P.M., the surface attained maximum temperature for the day. Significantly, the *Naga* balustrade, between the third and fourth enclosures, among the selected areas for the study, recorded the maximum temperature of 52°C, and also maximum variation of 23°C. However, the highest temperature recorded on the roof of the fourth enclosure was only 43°C.

Angkor Vat being in the western part of Cambodia where the seaward sloping mountain ranges are situated, normally gets moderately heavy rainfall governed by northeastern (November to March) and southwestern monsoons (May to October). However, maximum rainfall is brought by the southwestern monsoon. It brings with it strong winds, high humidity and nearly 80 percent of 5000 mm rainfall.

Deterioration of building material due to extreme climatic variations and rainfall has been very well illustrated in Angkor Vat. For example, appreciable quantities of alkali silicates like feldspars in the sandstone used as building material are susceptible to rain water. Therefore, the areas which are exposed to the rain have been suffered the maximum damage. The clayey material in the sandstone has been leached away by the mechanical force of rain water. Then, gradually even the quartz and other mineral grains are carried away, causing erosion of the rock. This process of deterioration, though present in almost all parts of the monument, could be seen more prominently on the five towers of the first enclosure, where it had assumed dangerous proportions. On the upper parts of the towers the architectural members have been highly eroded and all carvings have entirely been destroyed. Further, some of the architectural members were precariously overhanging due to erosion.

Exfoliation of rock surface due to contraction and expansion owing to sharp variation in temperature could be seen extensively in the *Naga* balustrades of the first and second causeways, the *Naga* railing in between third and fourth enclosures and on the roof of all the enclosures.

Fortunately, the soluble salts like chloride and sulphate have not played any major role in the decay of the Angkor Vat complex. They are present in insignificant percentage. Among the 100 weathered rock samples collected from different parts of the monument, on examination 61 samples proved free from any chloride, whereas 34 samples were found to contain only faint traces of chloride, while remaining 5 proved positive. In the case of sulphate 60 samples gave negative result, 22 samples had negligible quantity of sulphate, and 18 samples were found to contain sulphate.

Significantly, the soil samples taken from below the four enclosures, on test, proved to have no traces of chloride or sulphate. Therefore, the presence of chloride and sulphate in the building material should be taken as components of the sandstone itself.

Another interesting but important test conducted is the moisture test in all parts of the monument. The moisture test at various levels confirmed that moisture is not passing from the soil below into the stone above. Therefore, it can be concluded that there was no capillary action anywhere in the monument.

CHEMICAL DECAY—It is a well established fact that the ancient monuments in the tropical region are affected by micro-vegetational growth. The Angkor Vat is no exception. In fact the entire exterior surface of the temple complex was covered with thick growth of a variety of cryptogamus organisms such as moss, lichens, algae and fungi. In addition, in the interior where there was seepage of rain water there were patches of dark and greenish moss.

The Archaeological Survey of India collected samples of all types of micro-vegetational growth and got them analysed in its laboratory as well as by the Department of Microbiology of Osmania University, Hyderabad and confirmed the results of earlier studies. Actinomycetes, which particularly attack sandstone have been identified at Angkor Vat. The frequency of occurrence of these micro-organisms on weathered stones indicate that they have played their own part in the complex process of deterioration of building materials. It is well established that the actinomycetes are capable of transforming nitrates into nitrites and sulphates into sulphides, and are often associated with thio-bacteria and particularly with nitrifying bacteria.

Another micro-organism present is a fungus identified as *Penicillum lilacnum*. It is available in wooly colonies, lilac to wine-pink in colour, and is found to occur extensively, particularly on the horizontal surface of plinths. The study of the distribution of growth on the monument shows that moss occur extensively over surfaces that are directly exposed to rain or water flow and remain damp for appreciable span of time.

Further, the study had identified two types of lichen growth. One is crustaceous type occurring in large round patches. It is powdery and white outside but light green inside. It is found to be tenaciously sticking to the rock surface. Another type of lichen is a foliaceous type of light blue occurring in needle-like colonies. Both types of lichens have equally widespread occurrence in the temple complex.

It is significant to note that even while collecting the samples of the cryptogamous organisms, it could be noticed that the rock surface had already been rendered quite friable. Therefore, there is no doubt that these organisms, in combination with the various physico-chemical factors, were contributing to the deterioration of stone.

In short, it can be concluded that in this temple complex, situated in the tropical region, the cryptogamous growth such as moss, lichen over the stone surface are not only covering the most beautiful carvings and presenting a monotonous appearance, but also damaging the surface by making microbes more deep by eating away the cementing materials and thus disrupting the matrix of the stone. In addition, the hyphae (micro-roots) of the same enter into the pores and secrete the organic acids which weaken the vital elements particularly grits of the stone. The eradication of such growths, therefore, is very essential.

Another important agency which is responsible for the decay of the sandstone and disfigurement of carvings is the urine and excreta of bats and birds. It is an accepted phenomenon that especially the urine and excreta of bats contain high percentage of acids and salt, which not only accelerate the decay of the sandstone but also disfigure the carvings. The whole monument, especially the towers had become abode of millions of bats. They have played havoc with the temple complex.

2. CHEMICAL TREATMENT (pls. LXIX-LXXX)

The method used by the Archaeological Survey of India, in chemical cleaning and preservation of this magnificent and beautifully carved temple complex, Angkor Vat, was very simple. In the first

instance, the surface was moistened with water by spraying. Then the area was cleaned with 1 to 2 percent solution of liquid ammonia, used only to neutralize acids secreted by the hyphae of the micro-vegetation, mixed with teepol, a non-ionic detergent, and by brushing gently with nylon brushes or tooth brushes or soft coir brushes, as the situation demanded. The surface was therefore cleaned thoroughly with water. The area thus cleansed was treated with 2 percent solution of polycide, biocide and zinc silico fluoride seperately. Finally, after complete drying of the area, it was preserved by applying a coat of 2 percent of polymethyl methacrylate in toluene.

Almost the entire monument covering an area of nearly 200,000 sq. m has been chemically cleaned and preserved. It is heartening to know that the chemical treatment on the surface of the stones has not only exposed the original colour and texture of the building material of the monument, but has also brought back the expressions on the faces of sculptured human and animal figures, which were not to be seen by any one and appreciate the supremacy of the Khmer sculptors over their proud art. The *torana* decorations of the second enclosure are the mute testimony of this good work.

However, the cryptogamous growth is reappearing within a few years on the surface of the stones. This is only due to the reasons that the growth is deep rooted and is not possible to eradicate in one or two process of chemical cleaning. Therefore, the process will have to be repeated several times to bring the cryptogamous growth under complete control.

CHAPTER V

CONCLUSION

Since time immemorial India and Kambujadesa, the present Cambodia, had close interaction not only in the sphere of trade but also in the field of politics and culture. This traditional and historical bond between the two countries is so strong that no recent political developments in both the two countries could them keep away from each other. Such is the relationship between the two countries.

Naturally, when the state of Cambodia (Kampuchea) appealed to the world community in 1980 to save the Angkor monuments, India was the first nation to respond due to its strong concern for the heritage of Cambodia, which is the testimony to the cultural bond between the two countries. Since 1986, the Archaeological Survey of India with the unstinted co-operation of the Government of Cambodia has carried out the structural conservation and chemical preservation of Angkor Vat for seven seasons.

It is needless to stress that it is undoubtedly a herculean task to conserve a monument like Angkor Vat which expresses a harmonious blend of massiveness, monumentality and artistic details, and is remarkable for experimentation in bold and elaborate architectural arrangements and sculptural compositions. However, the temple-complex could be conserved to a major exent through the contribution of nearly 20,000 specialized supervisory man-days by the Government of India and more than 400,000 man-days of labour by the Government of Cambodia. Imagine the magnitude of work carried out for this monument! More than 9,000 architectural members, approximately covering 2,000 cu. m have been reset in their proper original positions, and several hundred pillars and architectural members have been mended and strengthened in the process of structural conservation and more than 100,000 sq. m surface area has been chemically cleaned and preserved. In addition, all the structures including towers of greater height and roof areas have been watertightened. It is important to remember that the Archaeological Survey of India, a unique organization in the world, has assiduously used the time-tested principles and methods in its works in Angkor Vat.

Though this gigantic monument could not be brought to its original pristine glory, it has been conserved thoroughly and saved from further deterioration, and has been brought to a presentable condition for the posterity through persistent and sustained seven seasons' efforts by the Government of India in co-operation with the Government of Cambodia.

However, the Archaeological Survey of India could have achieved better target than what has been achieved in seven seasons of work, if there were no constraints. In the first instance the materials and equipments required for structural conservation and chemical preservation had to be brought from India, as they were not available in Cambodia. Often the consignment with materials and equipments would not reach Siem Reap in time. Owing to this delay the work would suffer. Especially in the first two seasons the work suffered due to these reasons only.

Another major constraint was the non-availability of skilled labourers. In fact, the labourers of Cambodia, though extremely intelligent and resourceful, had never worked for any organization like this, and it was a new experience for them. They were not particular about working hours. Therefore, we had to inculcate work culture in them, and train them in conservation work. Fortunately, they were quick in learning, and extended full co-operation in the execution of work by the Indian teams.

But, the constraints encountered by the 1992-93 team were far too many and of serious nature. In the month of February 1993, the male labourers who had been trained in the structural conservation stopped coming one by one. Enquiries revealed that our trained labourers were being attracted by the World Monuments Fund which had taken up conservation work at Preah Khan, the International Labour Organization which had taken up clearing of moat at Angkor Vat, and French team which was conserving the Elephant Terrace in Angkor Thom, by paying one US Dollar per day.

Came March, and the value of the Reils (local currency) crashed. It crashed from 1,500 reils per US Dollar to 5,000 Reils. Our labourers who were paid in Reils, and that too only 1,400 to 1,600 felt the pinch, and were extremely unhappy because they could see others working with the other teams were paid 4,000 to 5,000 Reils per day for less work. In addition, due to inflation, the cost of the commodities like rice, vegetables, fish etc., went sky-high. Therefore, unexpected exodus of the male labourers started. There was no possible way of holding them back. In spite of all the hurdles, the works could be kept in progress, because of our good relationship with the labourers.

We may recall here an incident which took place in the month of February that had a bearing on the working conditions of the team. On the night of 9 February, around 0130 hours we were woken up from our sound sleep by the thundering sound of rockets launched at the Conservation D' Angkor campus, in which the residences of the Team are situated. The gate of the campus was broken and nearly twenty persons fully equipped with rocket launchers, AK-47 rifles etc., entered the campus. The guards on duty ran for their safety, leaving the whole campus at the mercy of the attackers. Fortunately, the gunmen straightaway went to the Museum building, broke the entrance door open launching a rocket, and then collected 11 good pieces of sculptures and walked away. No doubt, it was a very well planned attack, because, simultaneously the other groups had attacked the UNTAC Bangladesh camp, UNTAC Hospital and a strategic road cross from where either military or Police of the State of Cambodia had to pass through to come to the campus. However, the operation was over within half an hour or so.

This was a shattering experience for the team members. It was a nightmare. However, as the days passed on, the life had become almost normal, though we were hearing the rumours that the gunmen may attack once again in the month of March. But March was fairly peaceful. But there was one more attack on the night of 6 April. This time the method of attack was extremely peaceful. They noiselessly opened the eastern gate, which is not in use. Then they rounded up the guards one by one without making any sound. After making sure that they had rounded up all the guards, they asked them to march towards the museum. They made the guards cut the locks and open the door, and

selected good pieces, and ultimately carried the sculptures to the road side, from where the gunmen walked away carrying the sculptures. Once again, they showed that they could come at any time and do whatever they wanted to.

By the time the gunmen attacked a third time on the night of 22 April, the local authorities had posted policemen and had equipped the guards. However, this time the gunmen entered through the western gate which is also not used frequently and is also very close to the museum. Unfortunately for them, the guard near the museum could see their entry in time and started firing at them. They responded by cross firing. Meanwhile, the police persons who were guarding the main gate on the south and residences of the team started moving towards the museum. Noticing this movement the gunmen fled.

After this incident, rumours were rife that Khmer Rouge will attack Siem Reap and Angkor Vat to capture them. It did happen. In the early hours of 3 May, four groups attacked Siem Reap simultaneously from four sides. One of the groups entered the city along the river Siem Reap on the east of the campus. The group was trying to cross the river near the campus. The policemen on duty in the campus saw this and tried to stop the gunmen. Ultimately, around 0730 hours the gunmen succeeded in crossing the river and were very close to the campus. Seeing the danger, the policemen went out of the campus, not worrying about the rocket and rifle attacks. They simply rushed towards the attackers blasting their AK-47s. This sudden and brave onslaught, the gunmen had not anticipated. In fact, one gunman was injured. Therefore, they retreated. After making sure that the gunmen had really retreated, the policemen returned to the campus. It was 0940 hours. But the fighting on other three fronts continued, as they had closed in at Market place. Ultimately, the Khmer Rouge had to withdraw around 1015 hours, leaving behind 15 dead and one captured.

Though they withdrew from Siem Reap, their activities continued for three more days in the peripheral villages, and there was every danger of their returning. Except for launching some rockets at Angkor Vat, as the temple was being guarded by Military and the Police , there were no fresh attempts on Siem Reap. But the rumours were making rounds that the Khmer Rouge will definitely attack with vengeance.

While we were facing all these problems, one more cropped up in the form of drying up of moats and wells around the monument from which water was being taken for the chemical preservation work of the monument. There was absolutely no water in the moat by the end of April. Therefore, it was decided to sink a bore-well in the premises for water for chemical cleaning and also for the tourists after our leaving Siem Reap. A bore-well was sunk. Water was in plenty. But, we could not use a drop of it. Because on the day the bore-well became operational, the Khmer Rouge attacked the villages nearby, and hundreds of families took shelter in the temple premises. Our bore-well.was the only source of water for those families. We did not want tó put the families in difficulty. Obviously, we had to think of other alternative that was to transport water from the river on the truck. That is what we had to do and we did, to keep the work in progress.

In spite of all the tensions and hurdles, the Archaeological Survey of India continued the work till 17 May 1993, and returned to India safely. Thus the third phase of conservation at Angkor Vat, the co-operation work between the Governments of India and Cambodia, came to end, two months before schedule.

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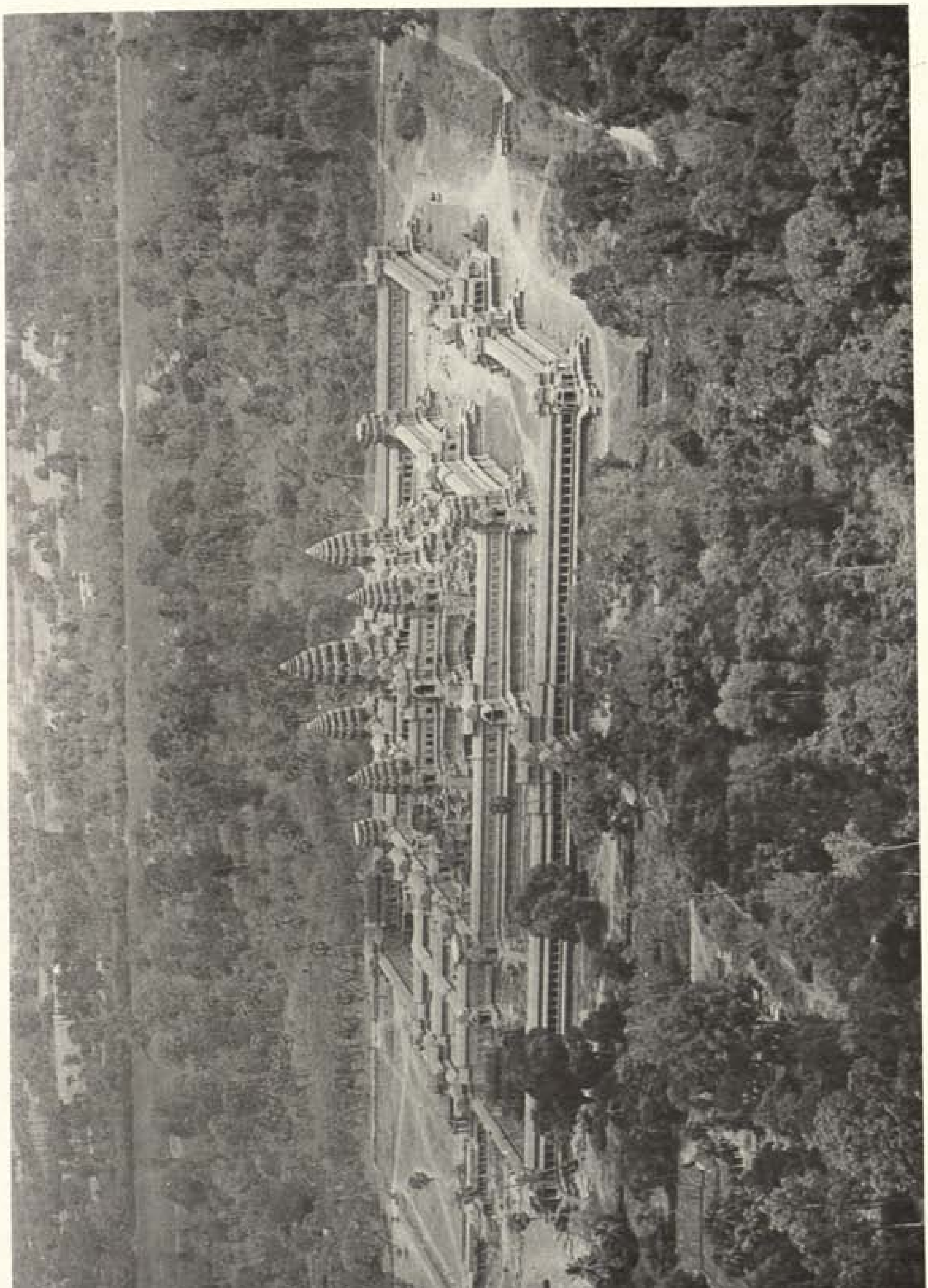
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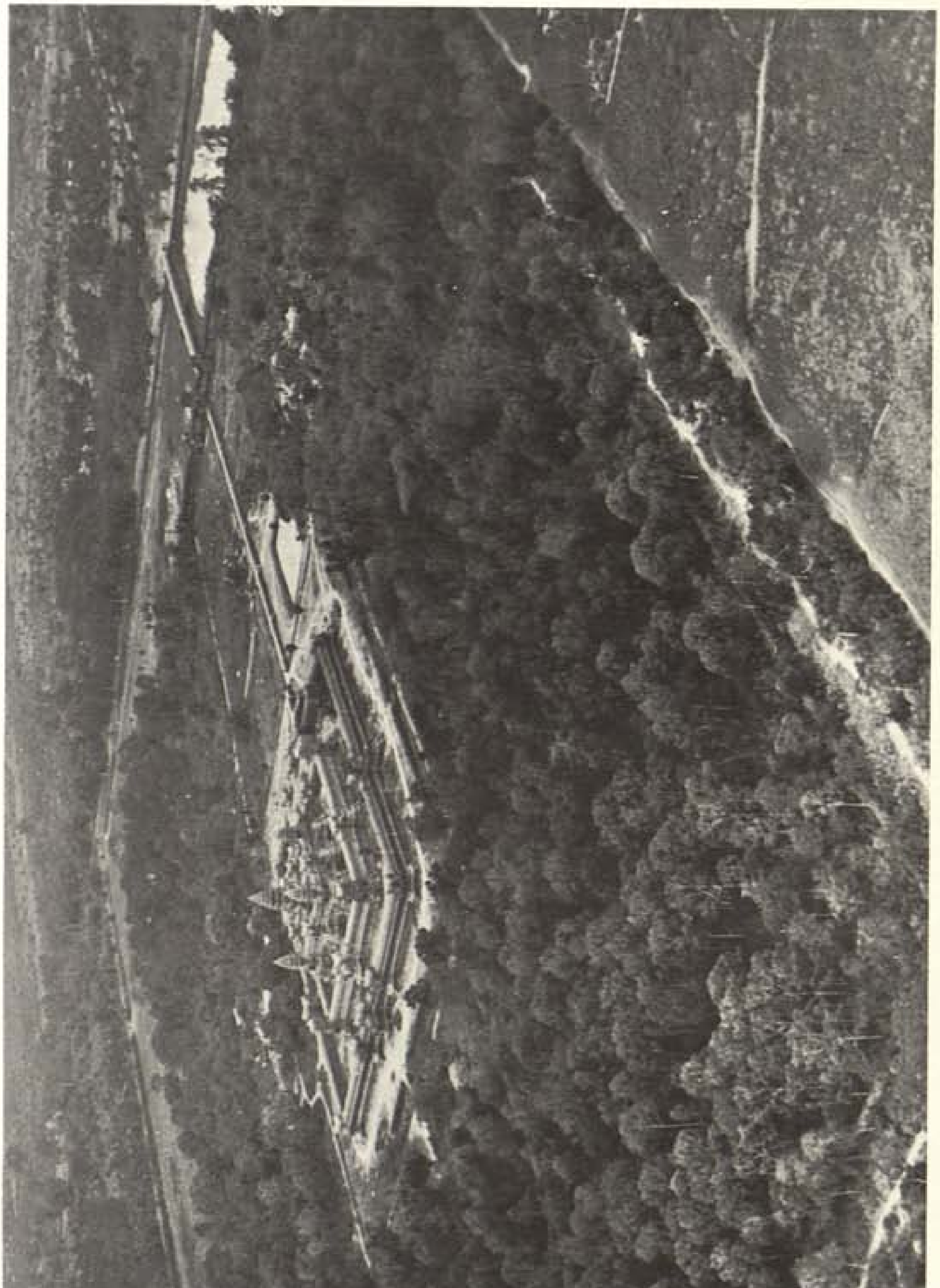
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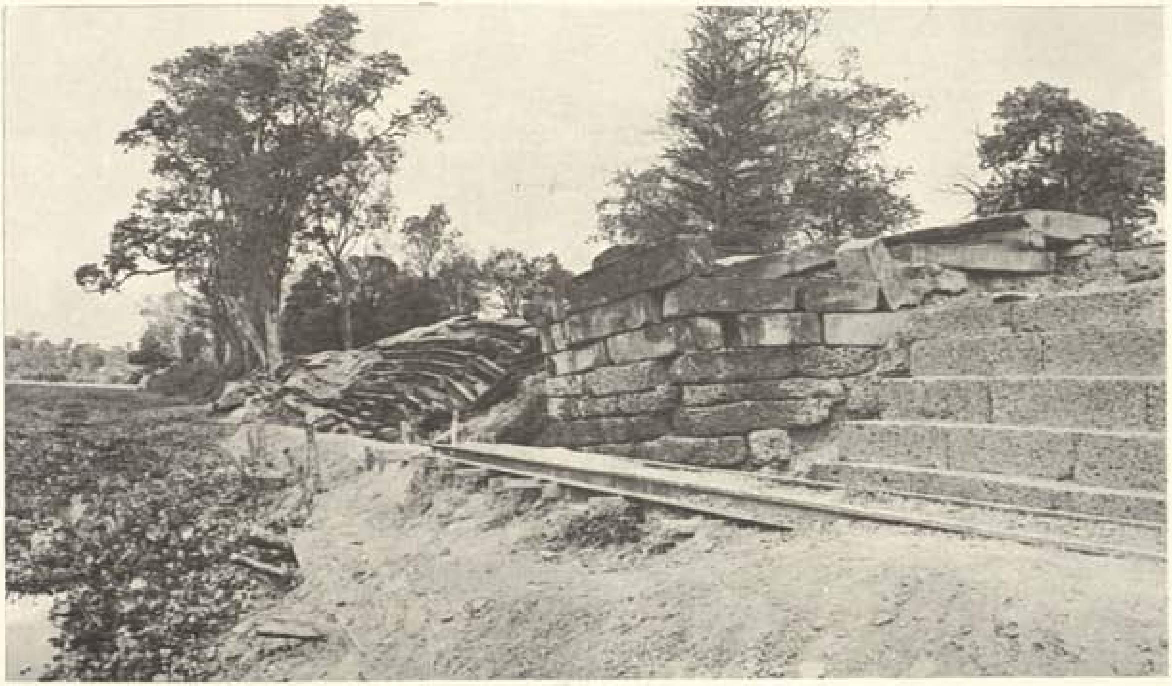
PLATES



Angkor Vat : general view



Angkor Vat : general view



A



B

Stepped embankment of moat : A, *before and* B, *after conservation*



A



B

Stepped embankment of moat : A, *before and* B, *after conservation*

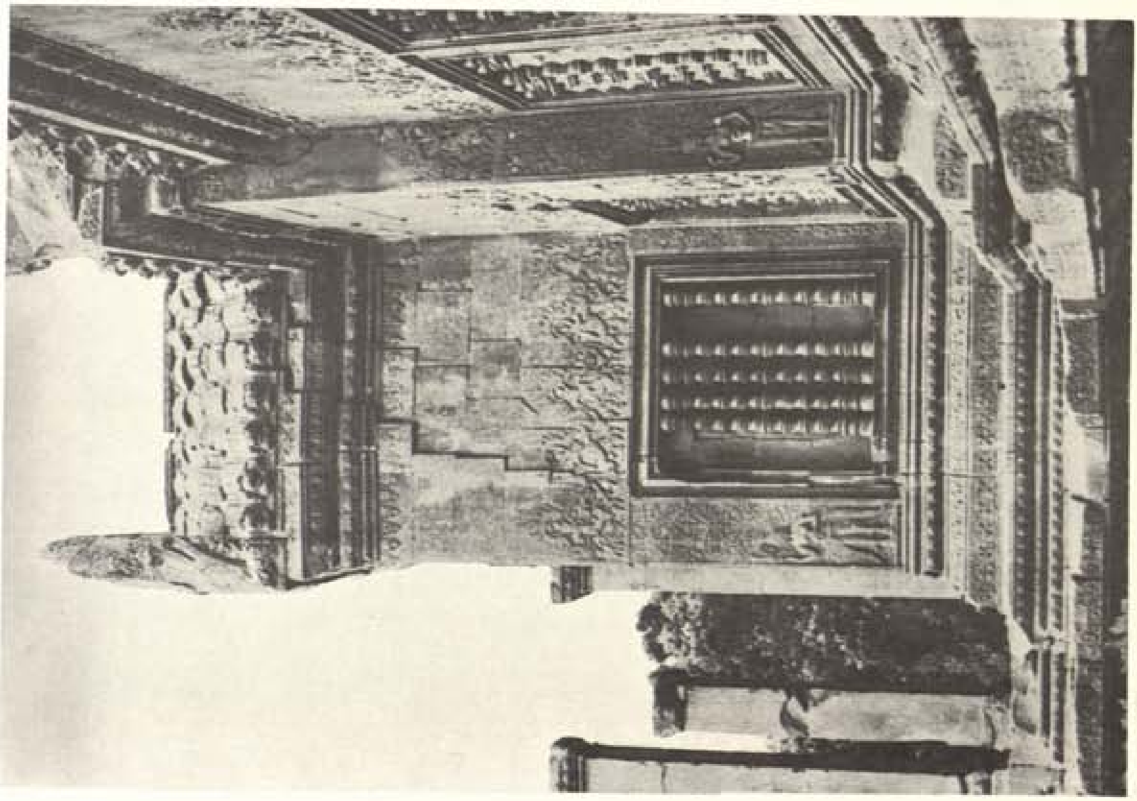


A

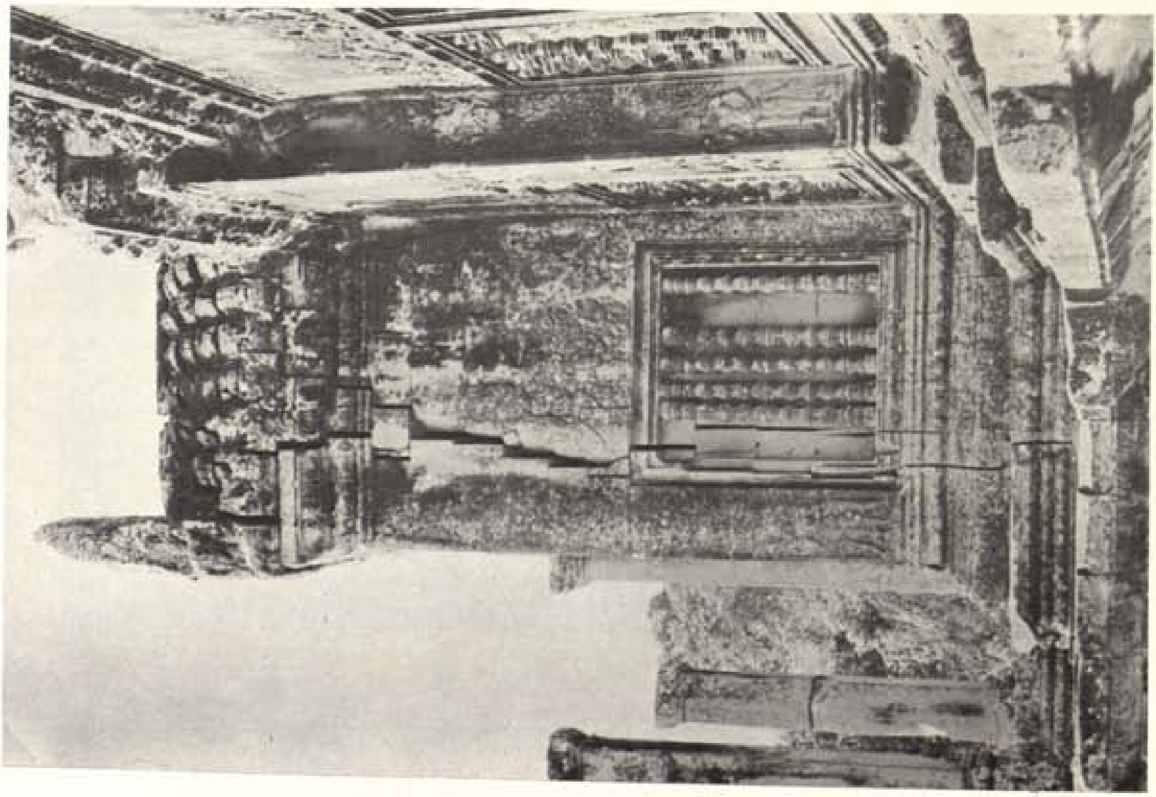


B

Stepped embankment of moat : A, *before and* B, *after conservation*



B

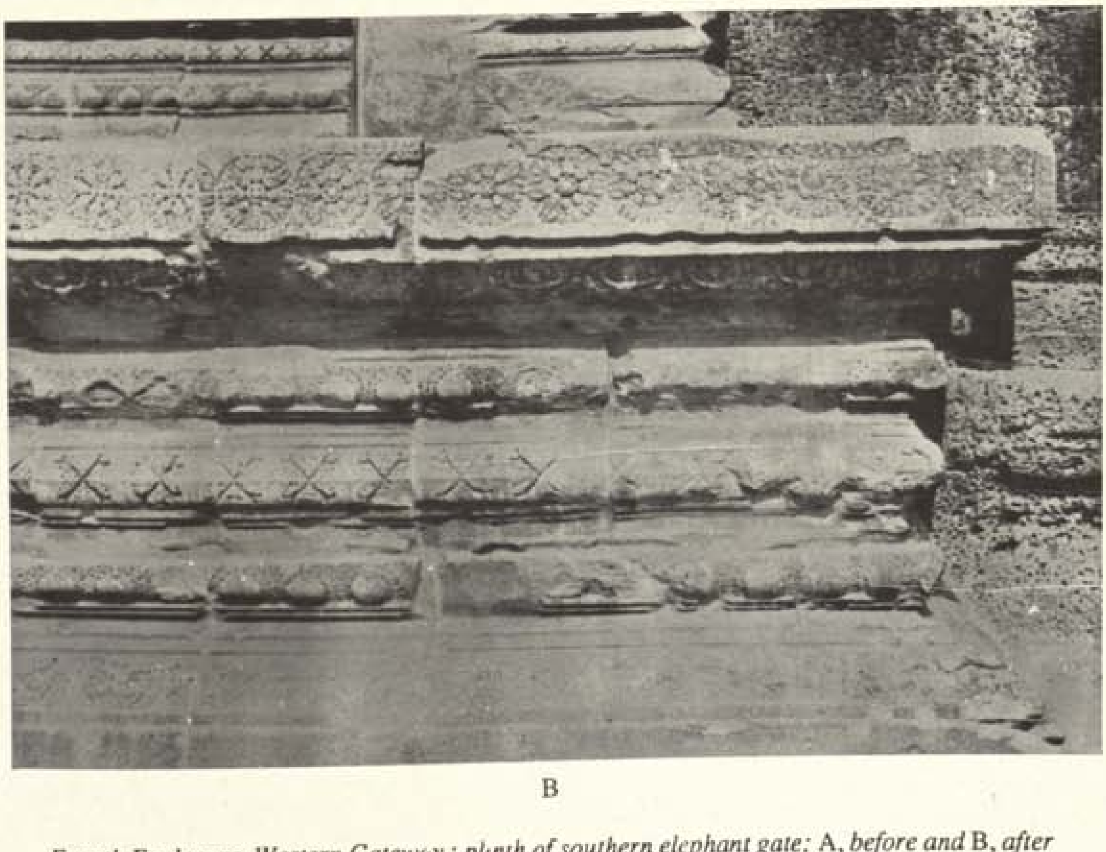


A

Fourth Enclosure, Western Gateway : torana of an entrance pavilion; A, before and B, after conservation

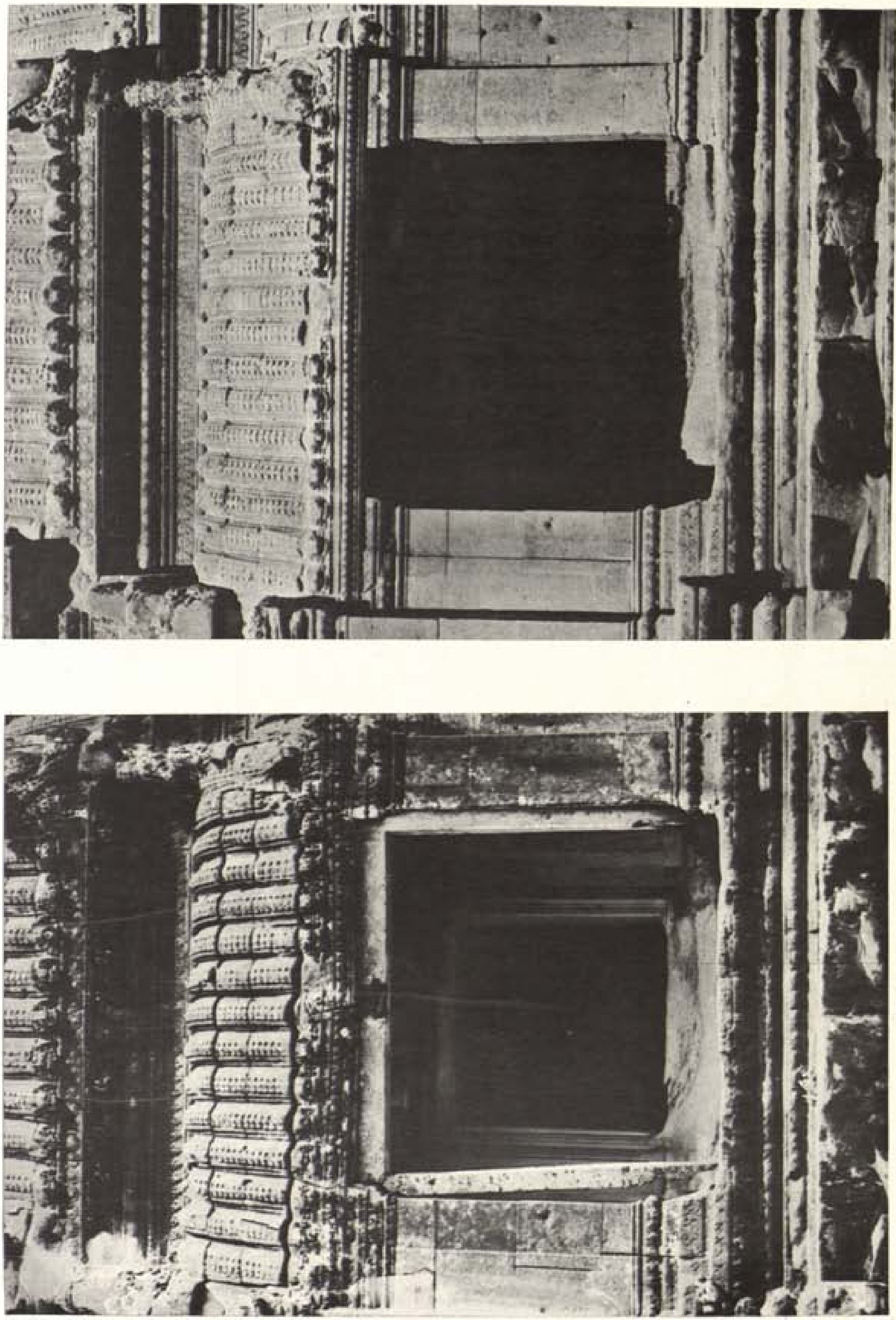


A



B

Fourth Enclosure, Western Gateway : plinth of southern elephant gate; A, *before and* B, *after conservation*



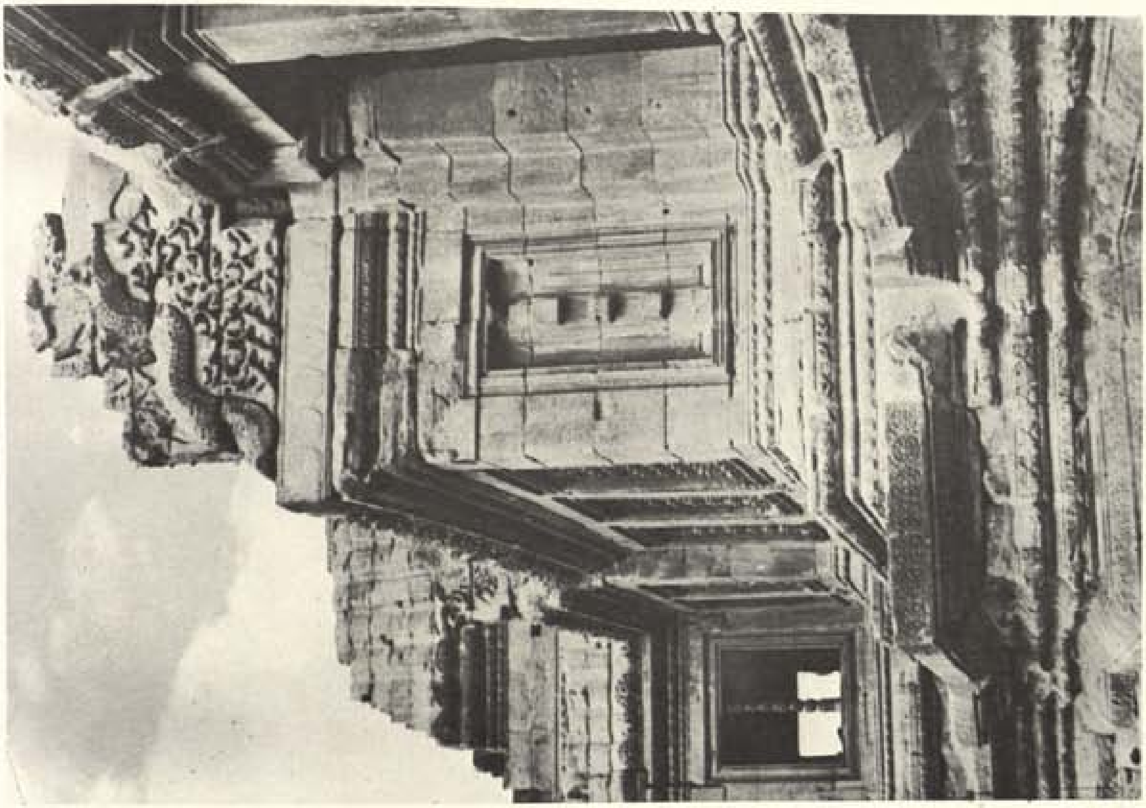
A

B

Fourth Enclosure, Western Gateway : beam of semi-vaulted roof, A, before and B, after conservation



A



B

Southern Library between Third and Fourth Enclosures : false window on the western façade, A, before and B, after conservation

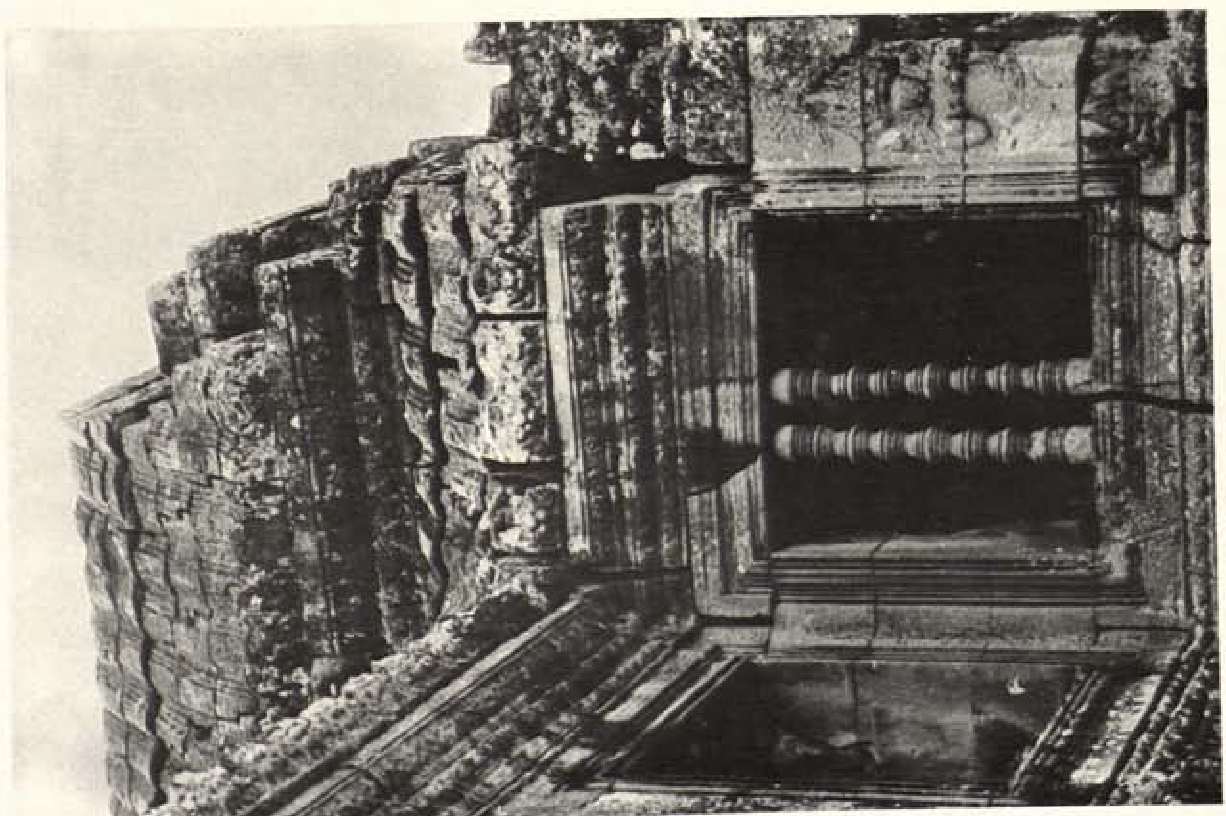


A

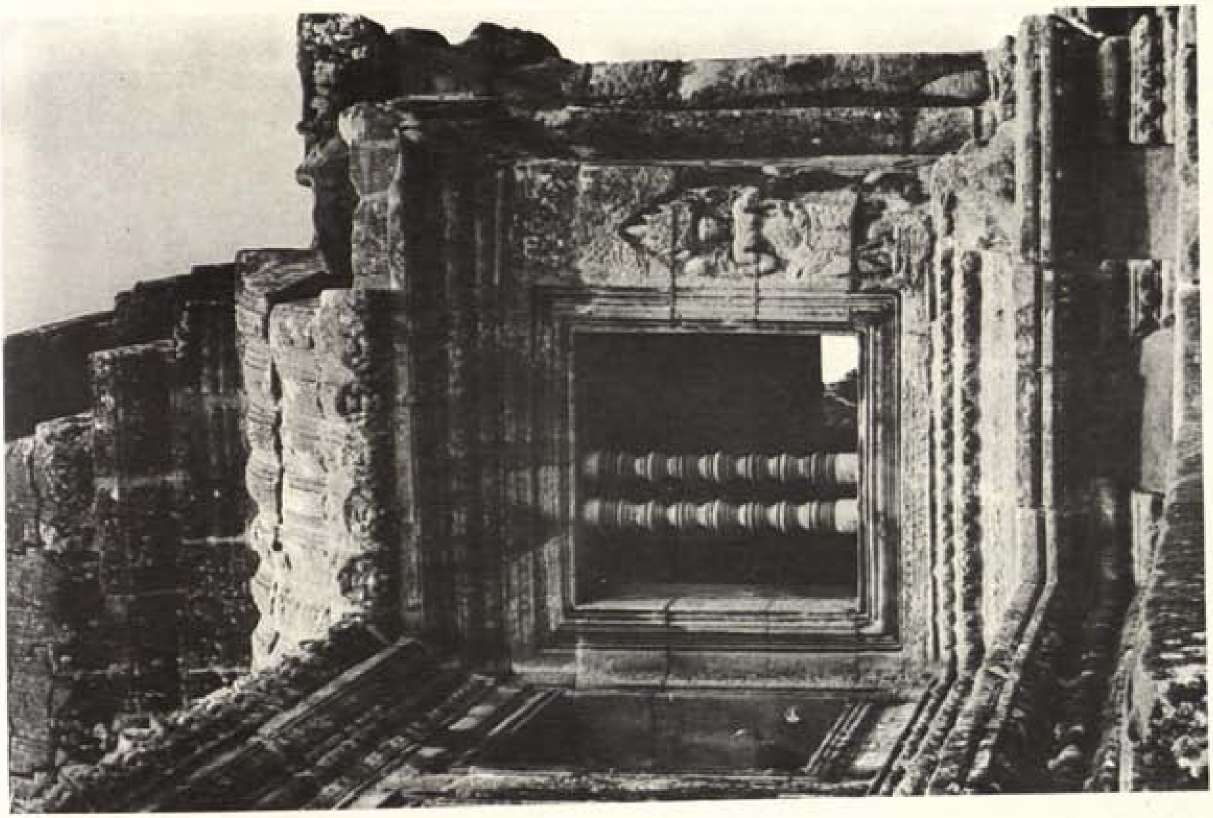


B

Southern Library between Third and Fourth Enclosures : western mandapa (pavilion), A, *before* and B, *after conservation*

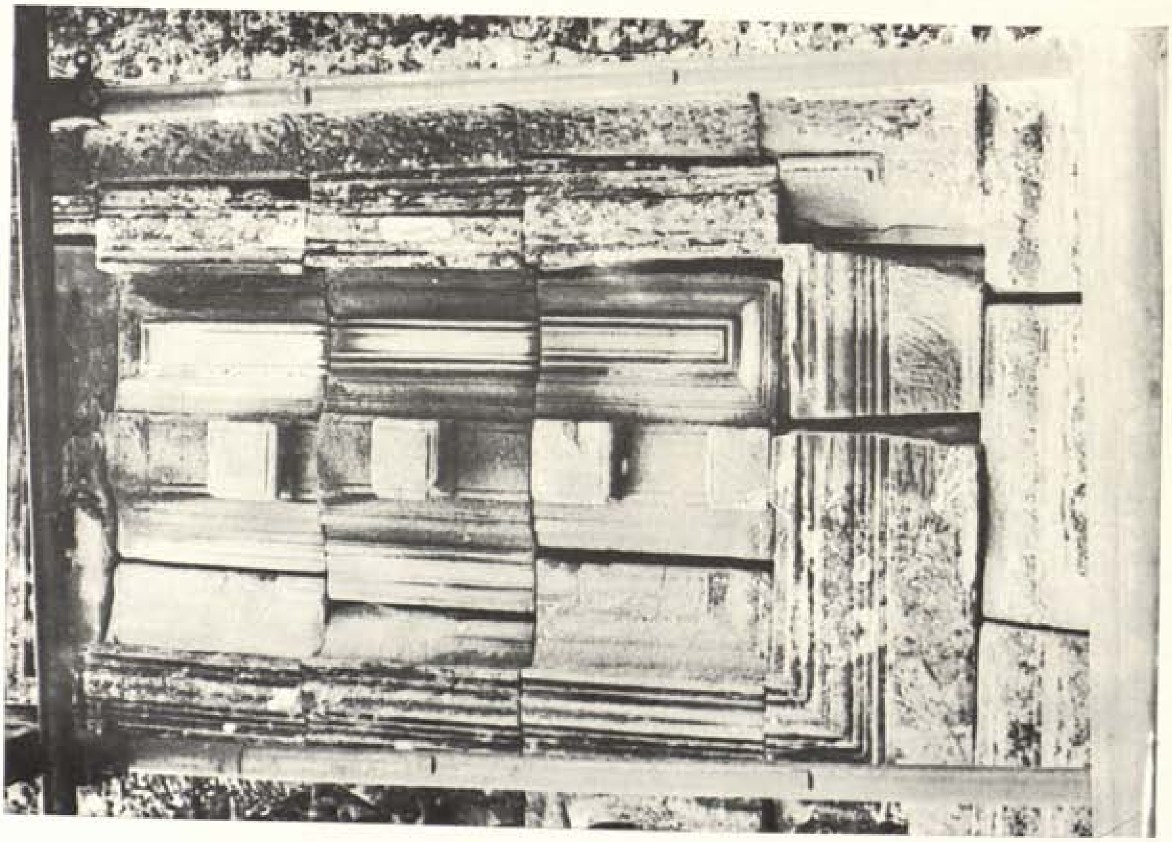


A

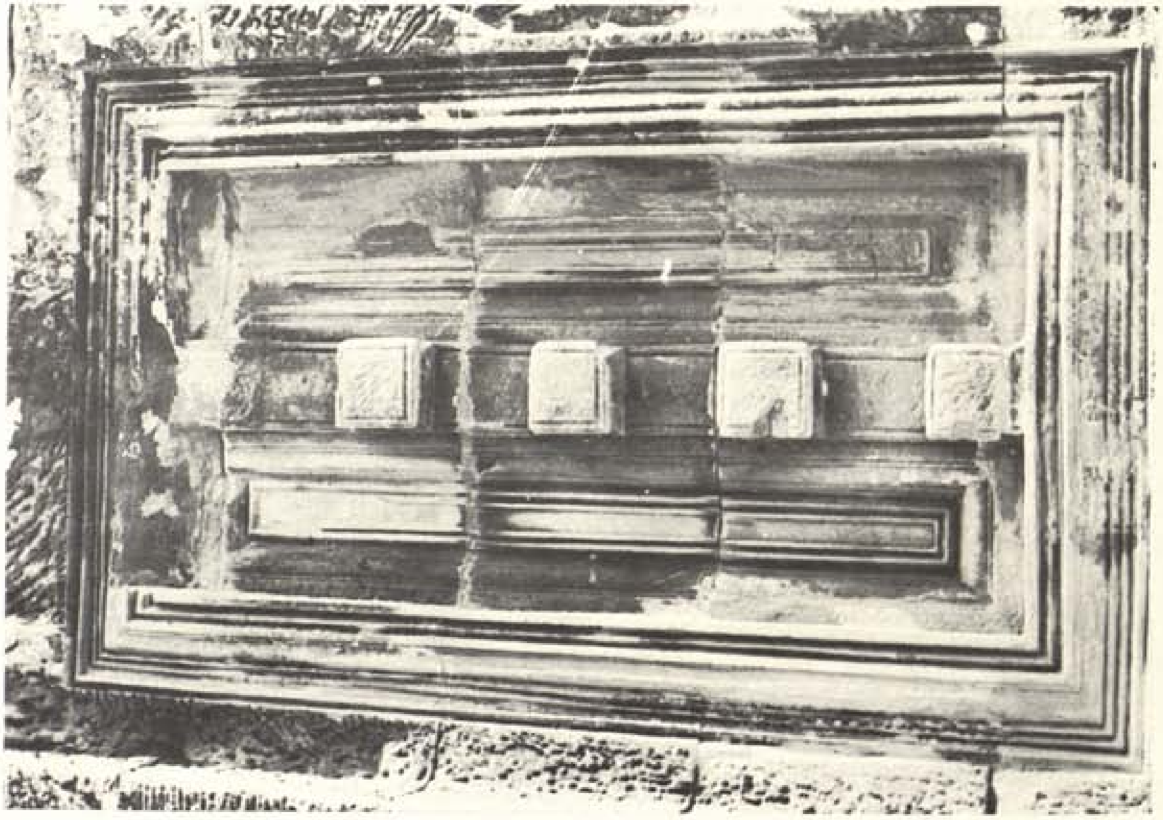


B

Northern Library between Third and Fourth Enclosures : verandah with semi-vaulted roof at north-eastern corner, A, *before and* B, *after conservation*



A

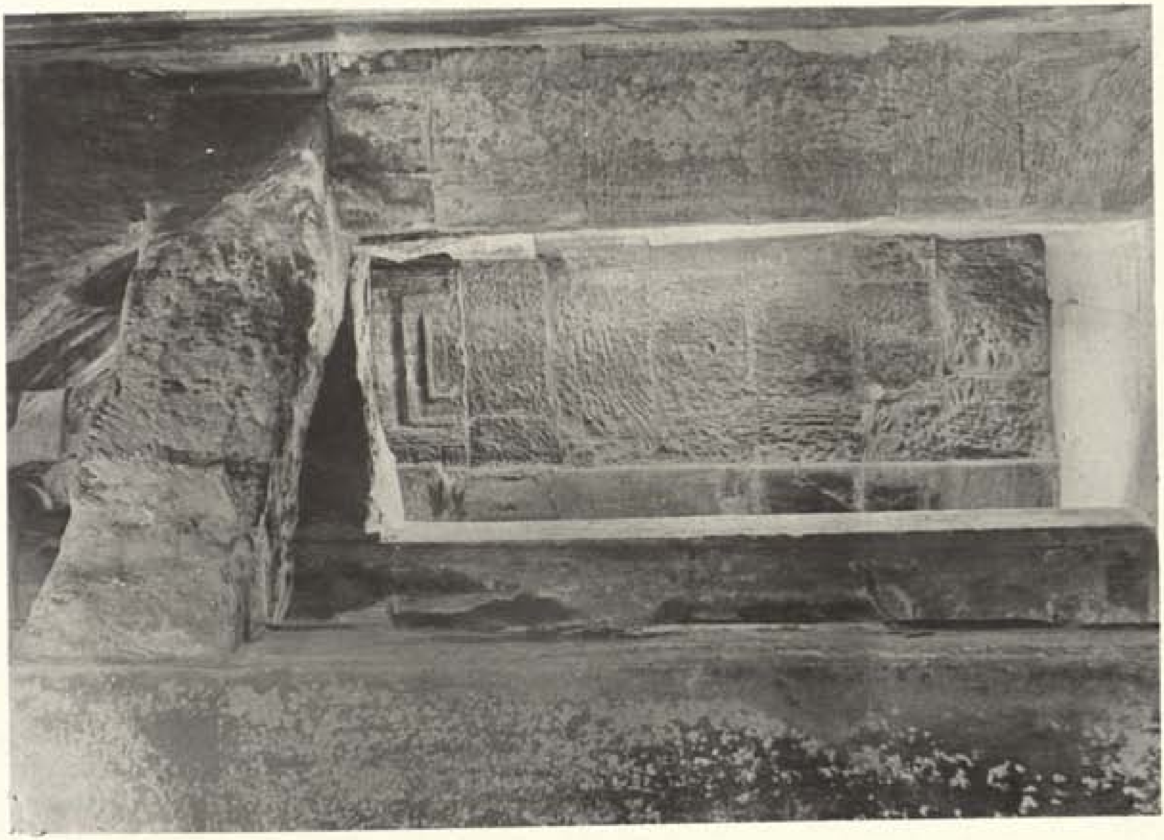


B

Northern Library between Third and Fourth Enclosures : false window, A, before and B, after conservation



A



B

Northern Library between Third and Fourth Enclosures : tie-beam of the verandah, A, *before and* B, *after conservation*



A



B

Northern Library : stepped entrance, A, *before and* B, *after conservation*



B



A

Northern Library : flooring, A, before and B, after conservation

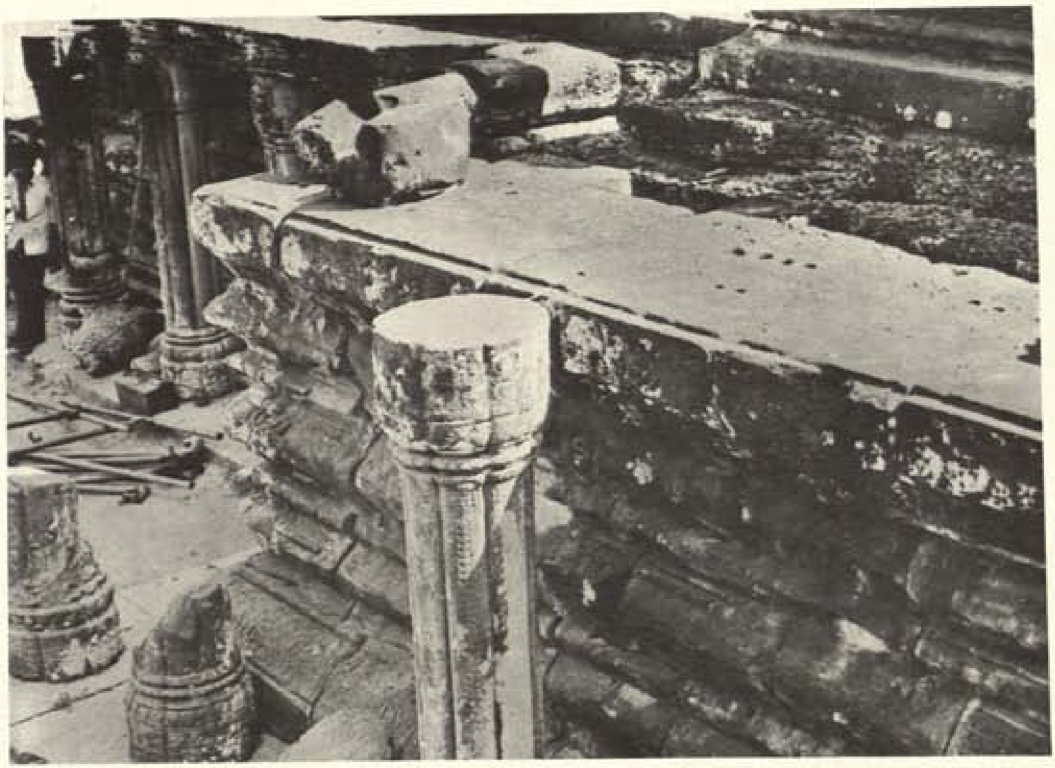


A



B

Esplanade (Ranga-Mancha) : *north-eastern portion*, A, *before and* B, *after conservation*

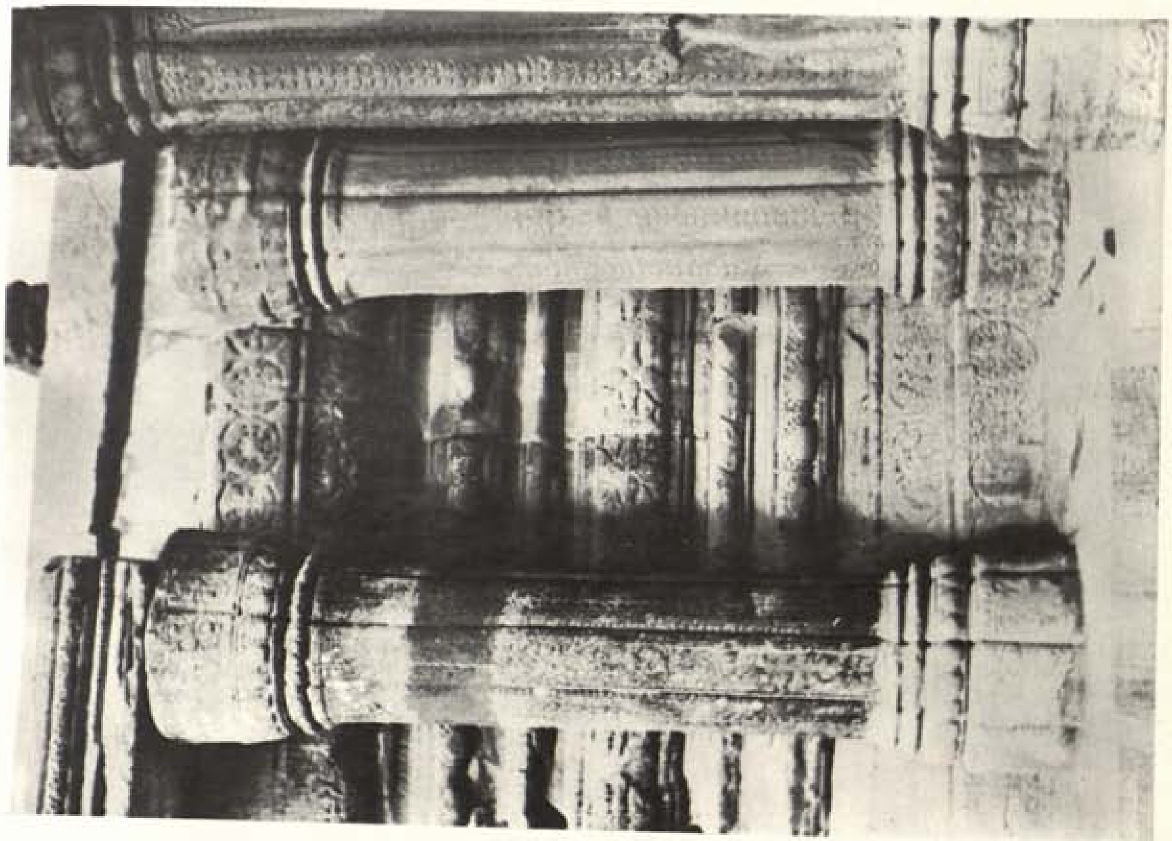


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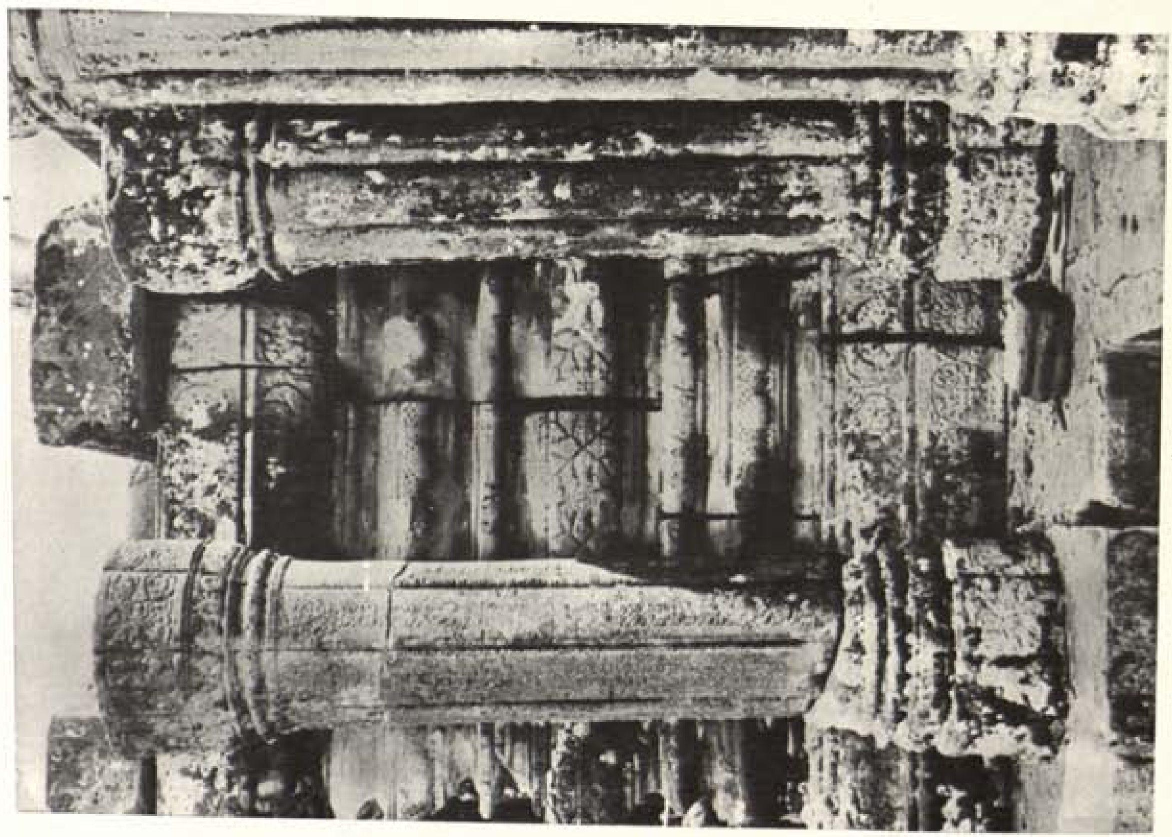


B

Esplanade (Ranga-Mancha) : north-eastern portion, A, *before and* B, *after conservation*



B

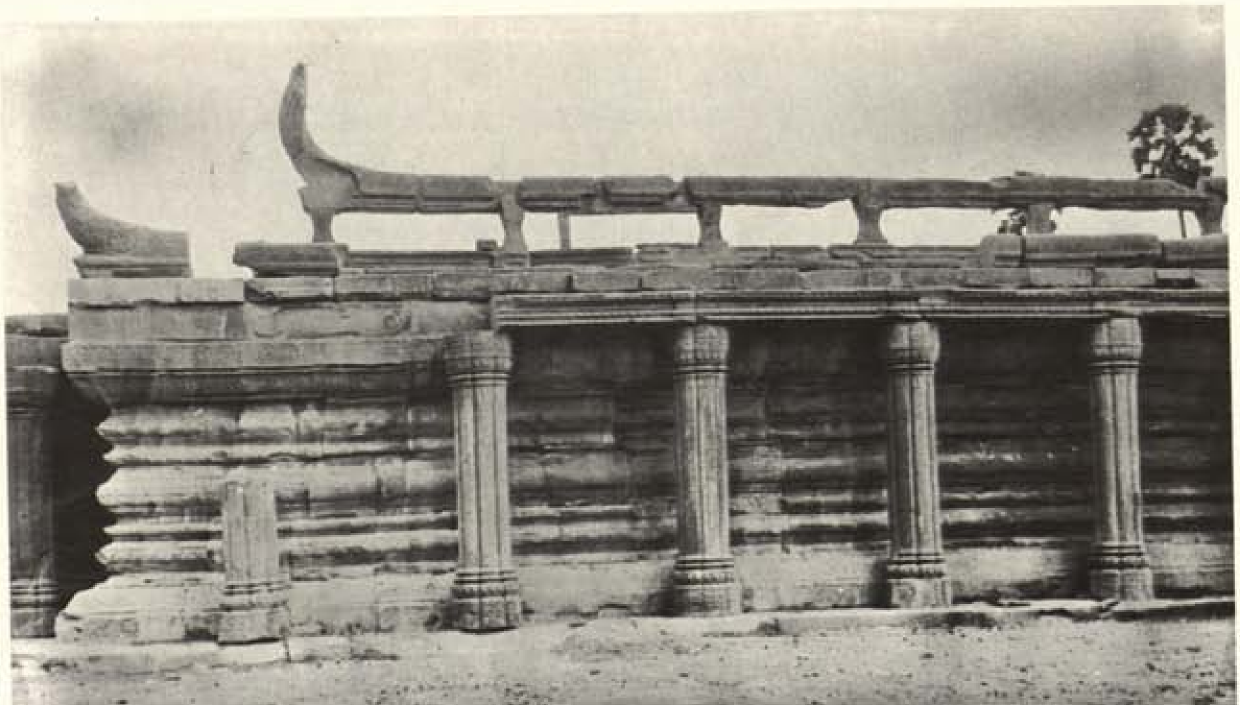


A

Esplanade (Ranga-Mancha) : north-western portion, A, before and B, after conservation



A

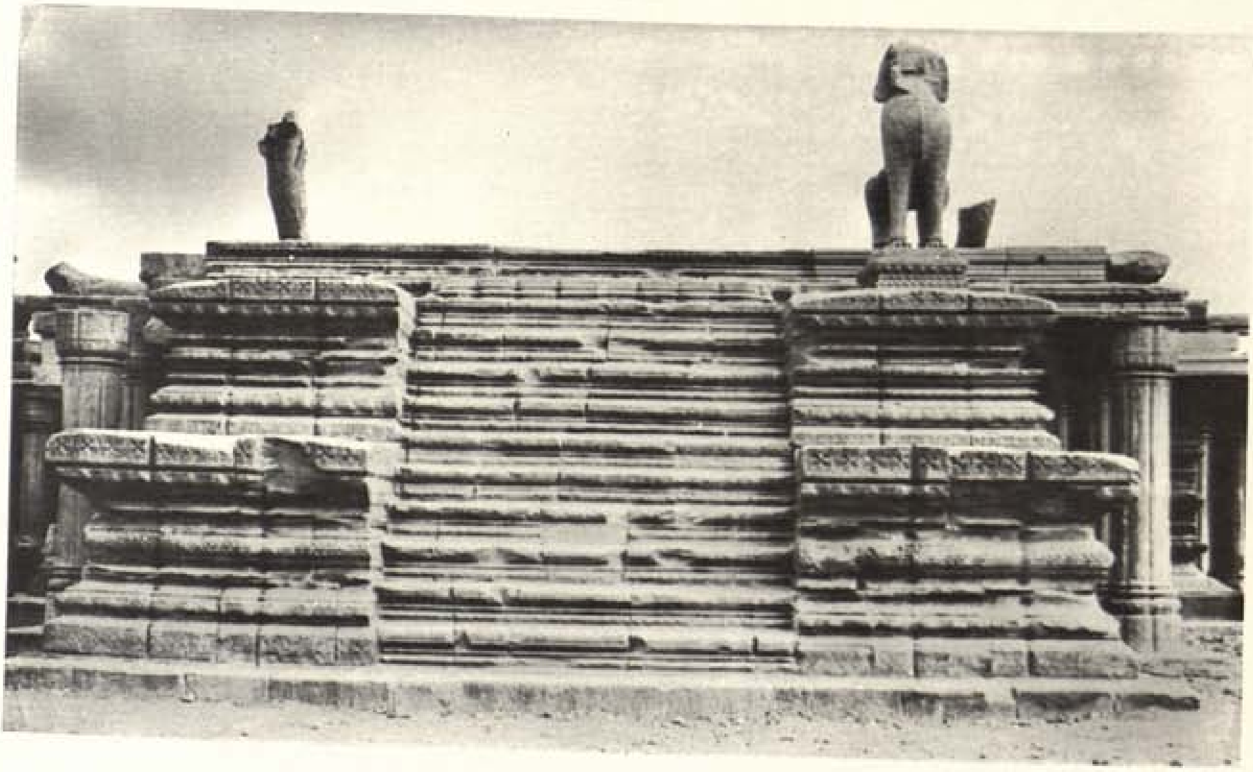


B

Esplanade (Ranga Mancha) : *north-western portion*, A, *before and* B, *after conservation*



A



B

Esplanade (Ranga Mancha) : southern stepped entrance, A, *before and* B, *after conservation*

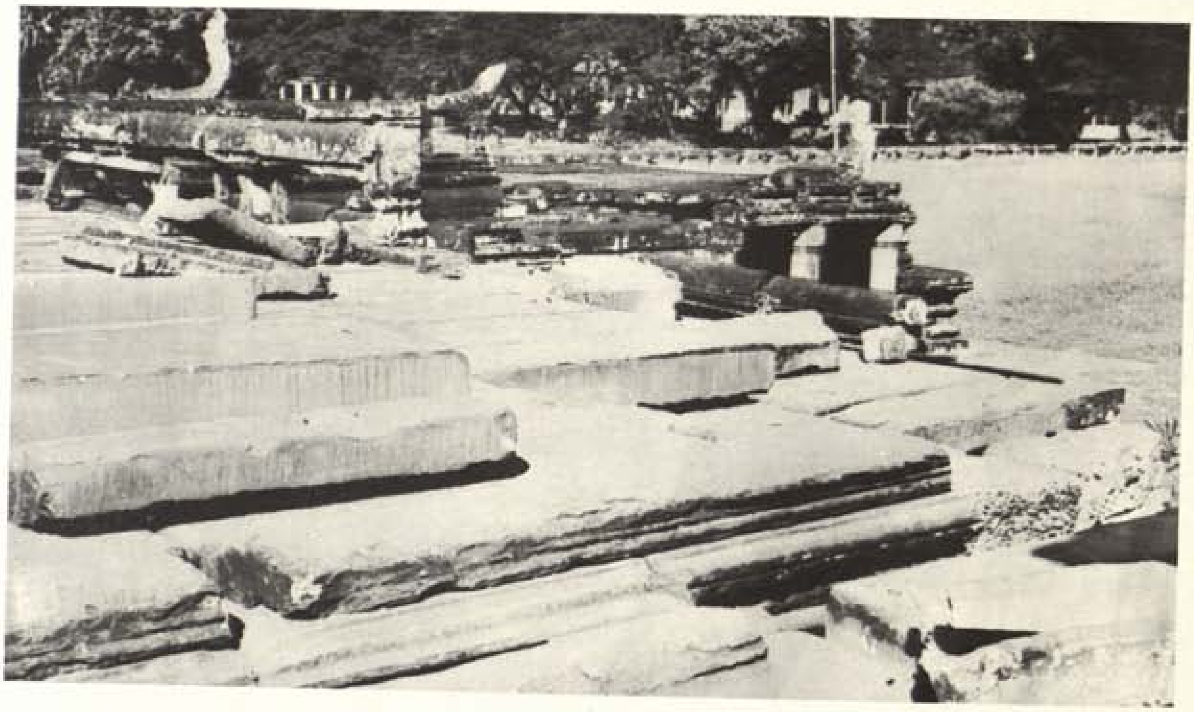


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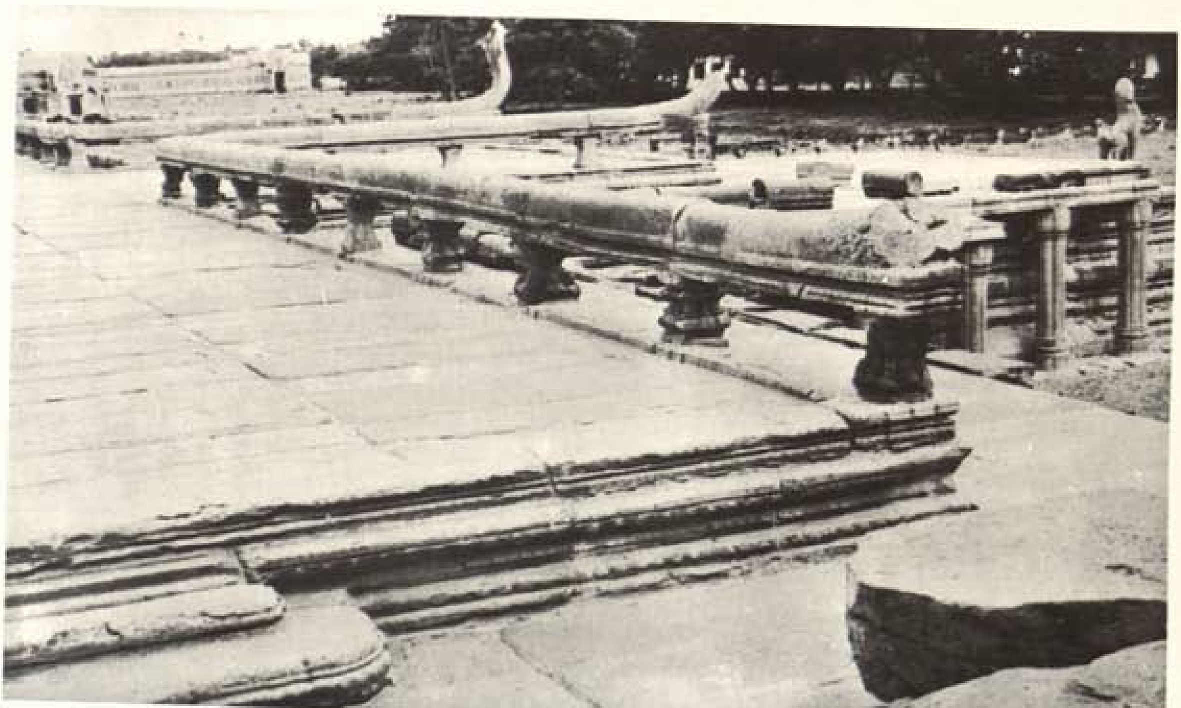


B

Esplanade (Ranga Mancha) : flooring, A, *before and* B, *after conservation*



A



B

Esplanade (Ranga Mancha) : flooring, A, *before and* B, *after conservation*



A



B

Third Enclosure : northern-central stepped entrance porch, A, *before and* B, *after conservation*



A

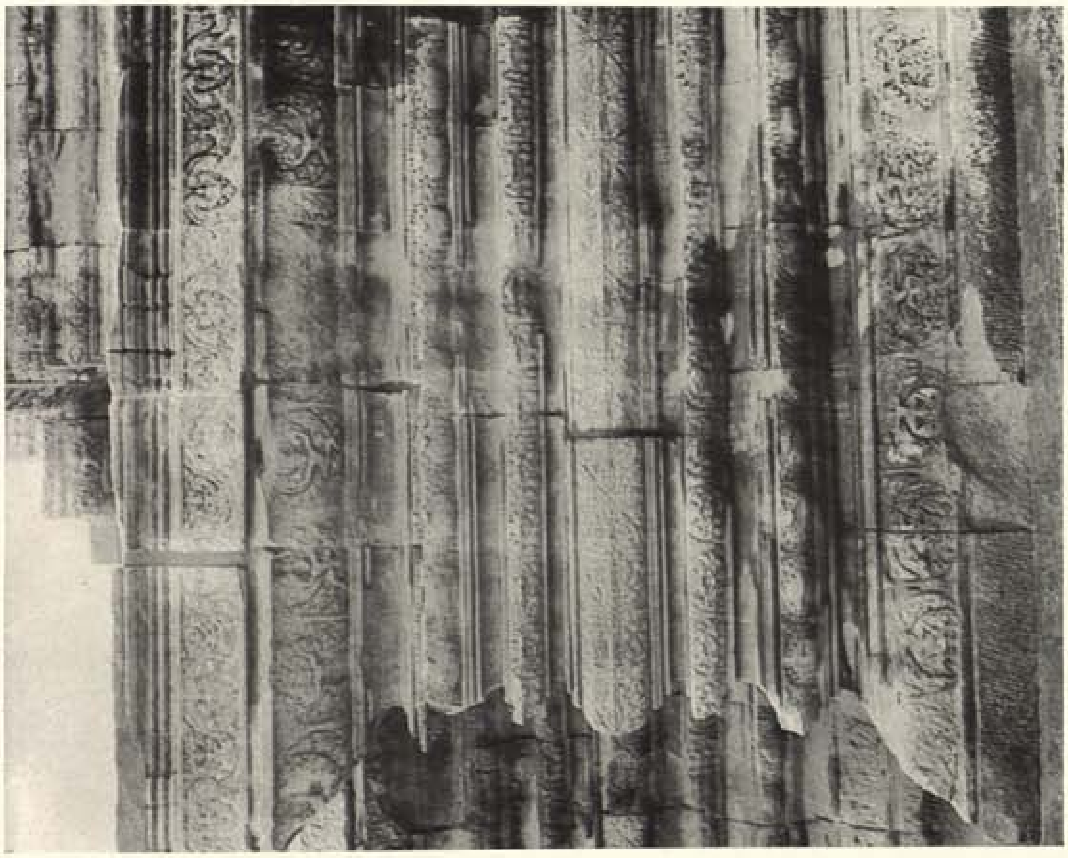


B

Third Enclosure : eastern-central entrance porch, A, *before and* B, *after conservation*

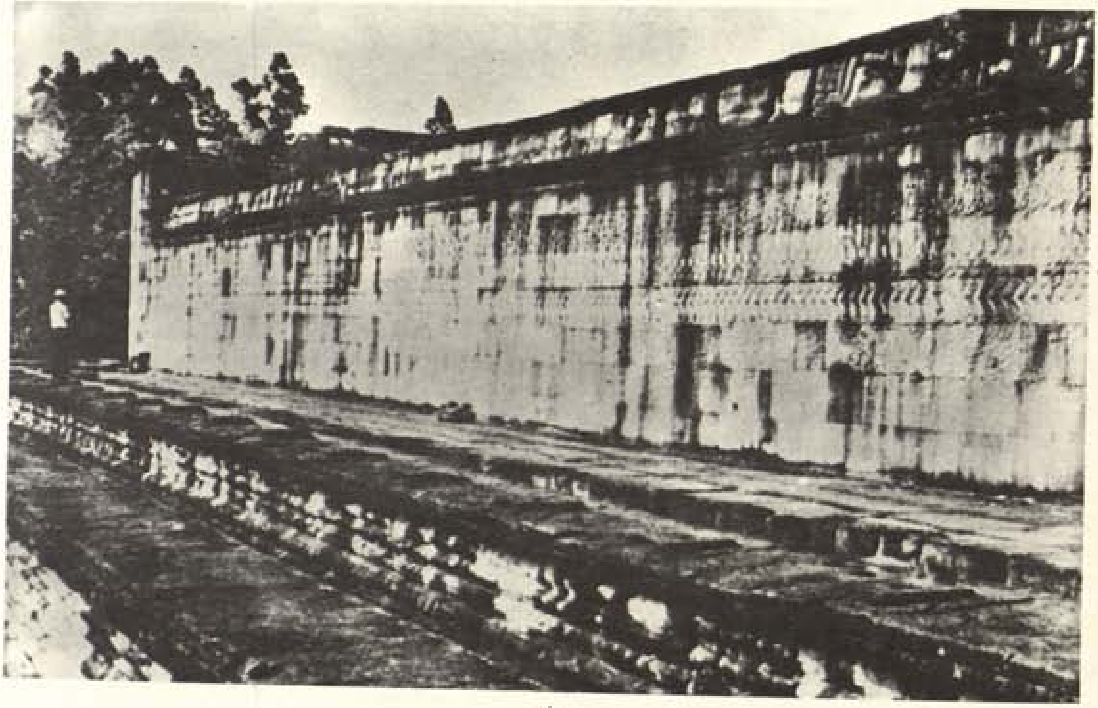


A



B

Third Enclosure : eastern-central entrance porch, A, *before and* B, *after conservation*

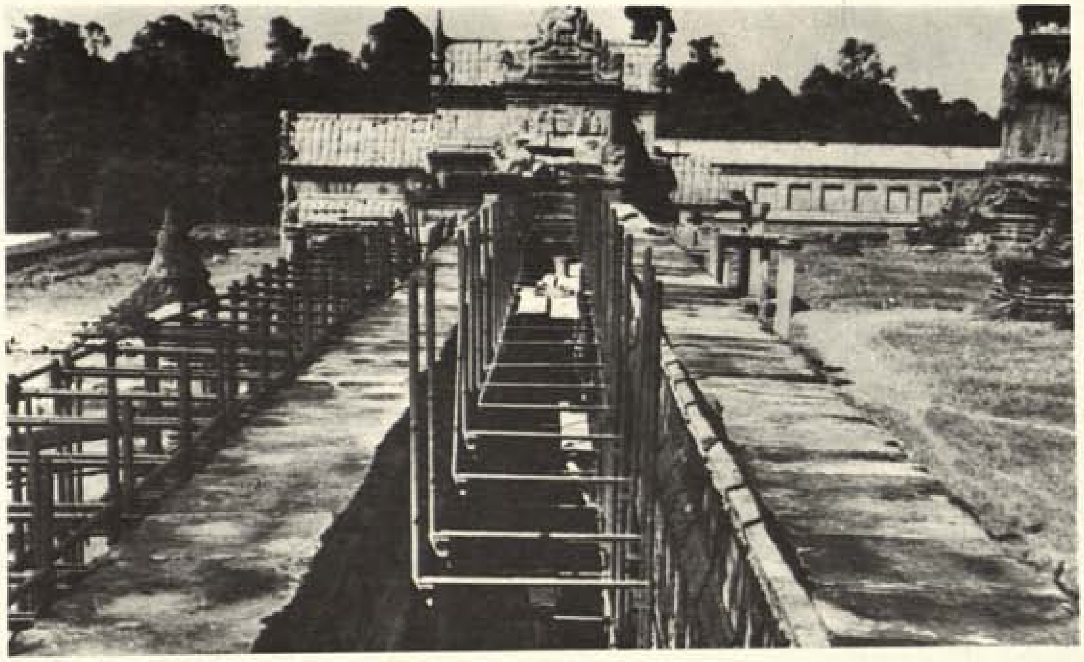


A



B

Third Enclosure : *Southern Gallery on eastern side (Samudramanthuna Gallery),* A, *before* and B, *after conservation*



A

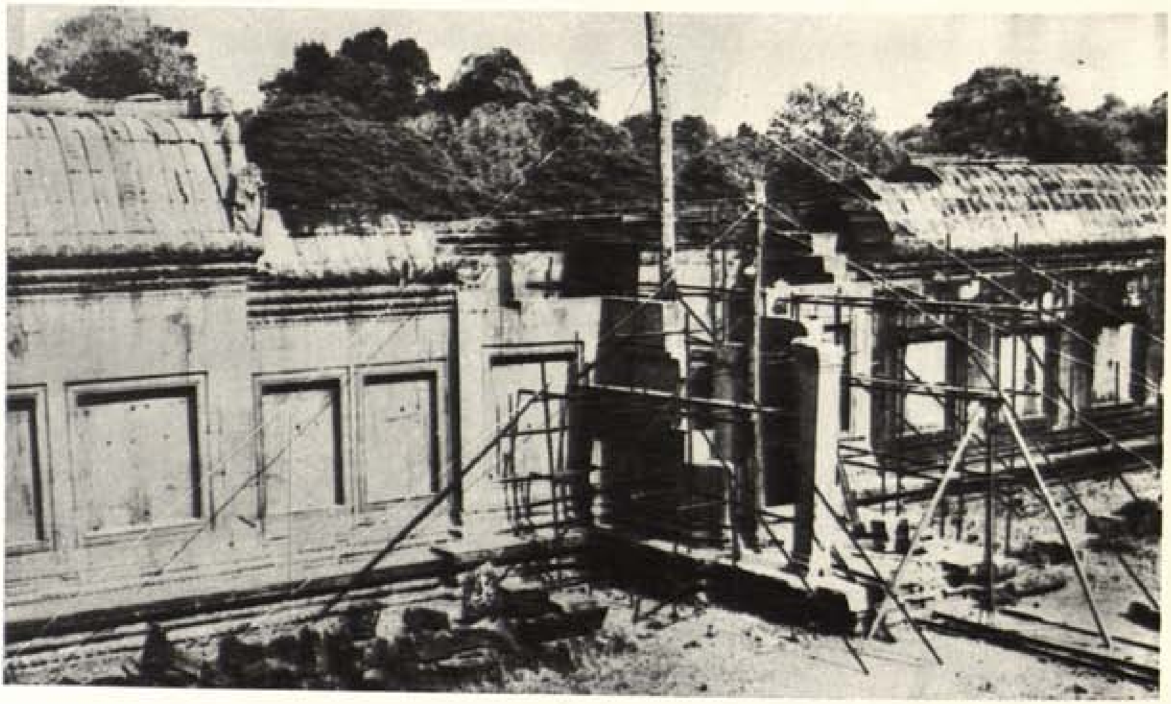


B

Third Enclosure : Southern Gallery on eastern side (Samudramanthana Gallery), A, *during and* B, *after conservation*



A

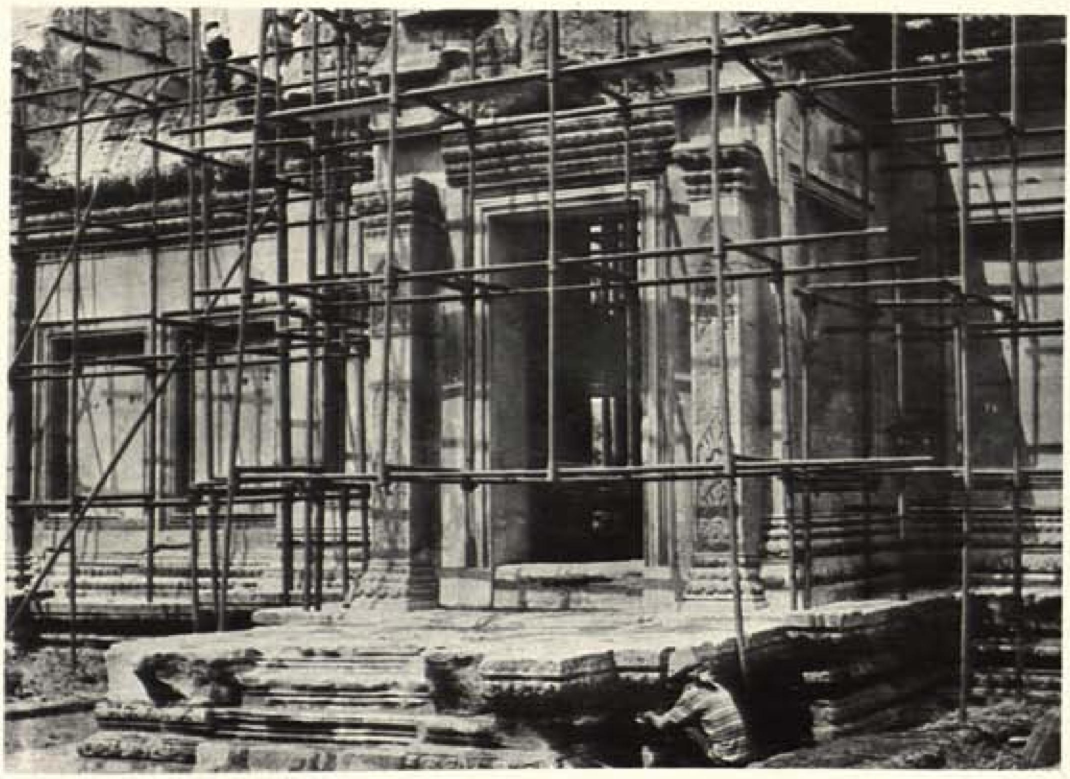


B

Third Enclosure : entrance pavilion north of Samudramanthana Gallery, A, *before and* B, *during conservation*

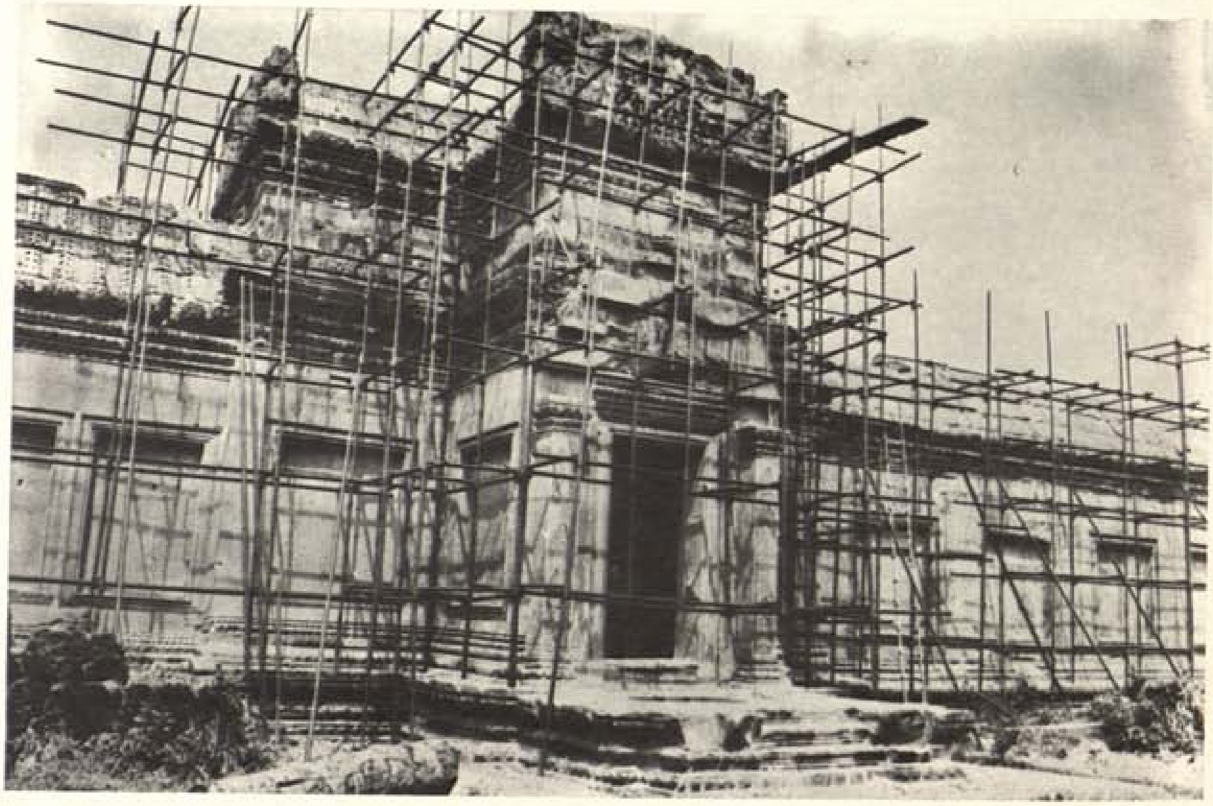


A



B

Third Enclosure : entrance pavilion north of Samudramanthana Gallery, during conservation



A



B

Third Enclosure : entrance pavilion north of Samudramanthana Gallery, A, *during and* B, *after conservation*



A



B

Third Enclosure : flooring, entrance pavilion, A, *before and* B, *after conservation*



A

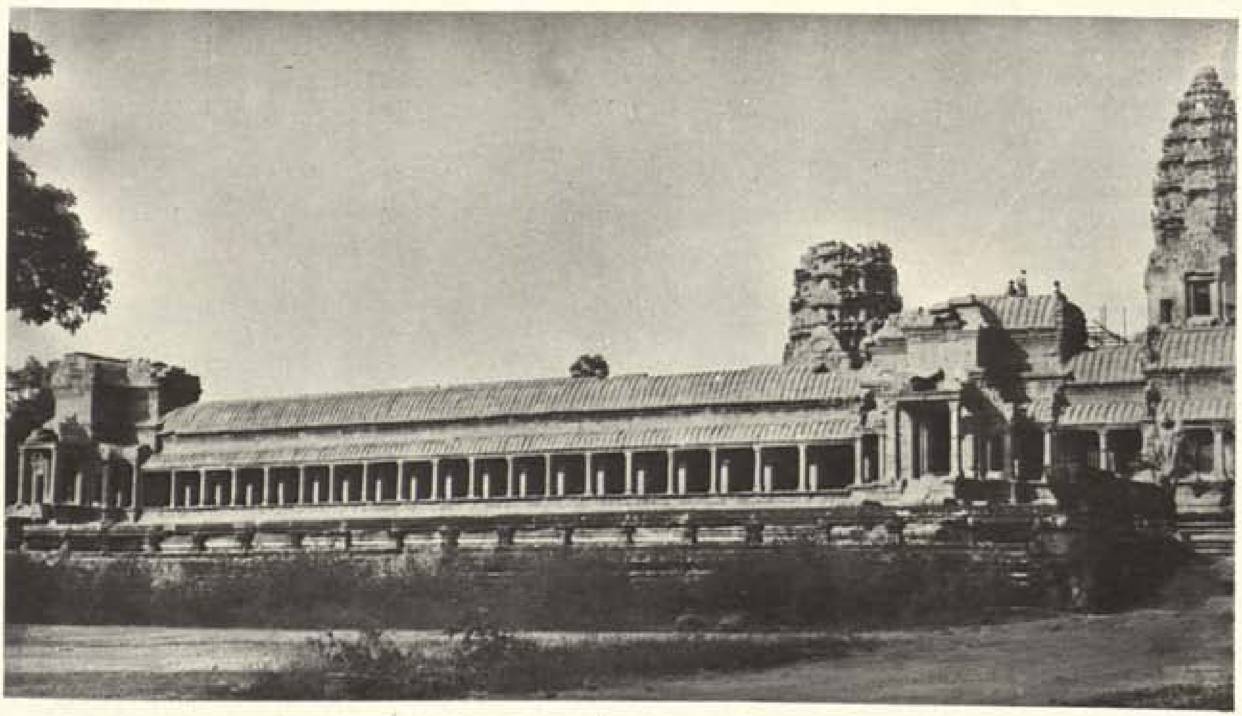


B

Third Enclosure : south-eastern corner entrance pavilion with porches, A, before and B, after conservation



A



B

Third Enclosure : Samudramanthana Gallery and flanking entrance pavilions. A, *before and* B, *after conservation*

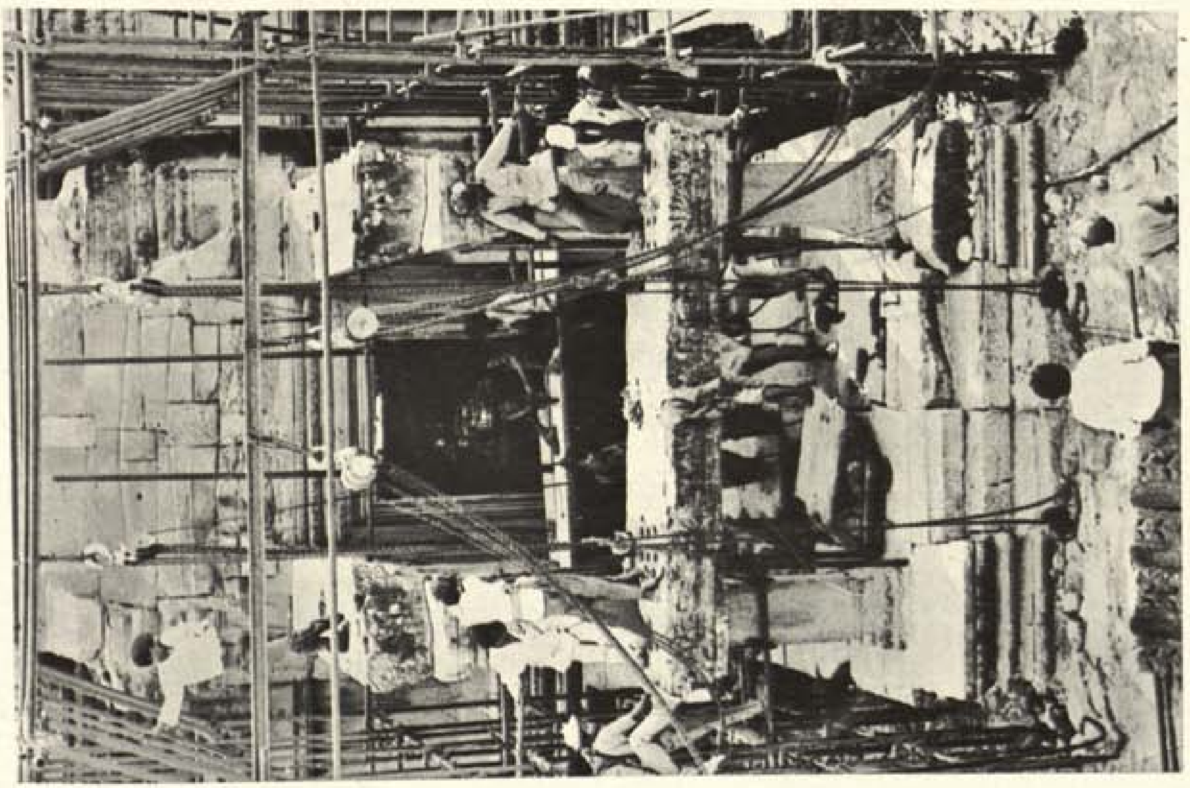


A

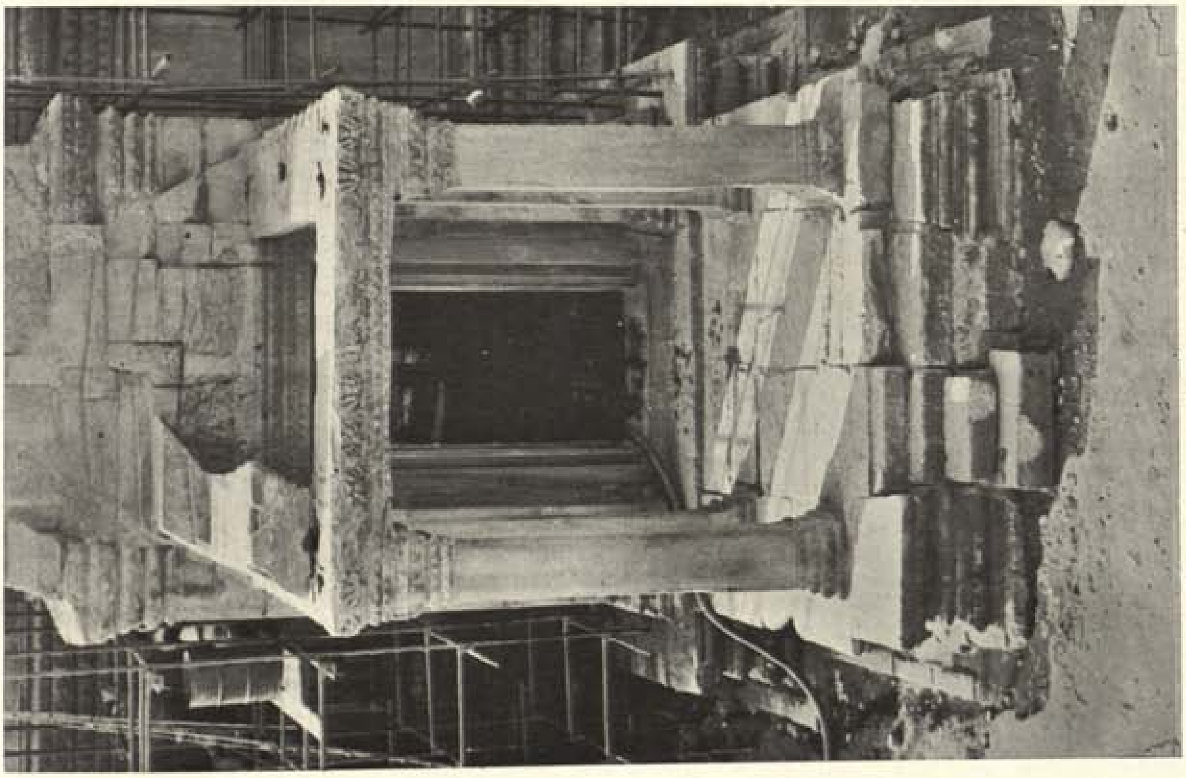


B

Third Enclosure : southern-central entrance porch, A, *before and* B, *after conservation*



A



B

Third Enclosure : inner entrance porch on southern side, A, during and B, after conservation

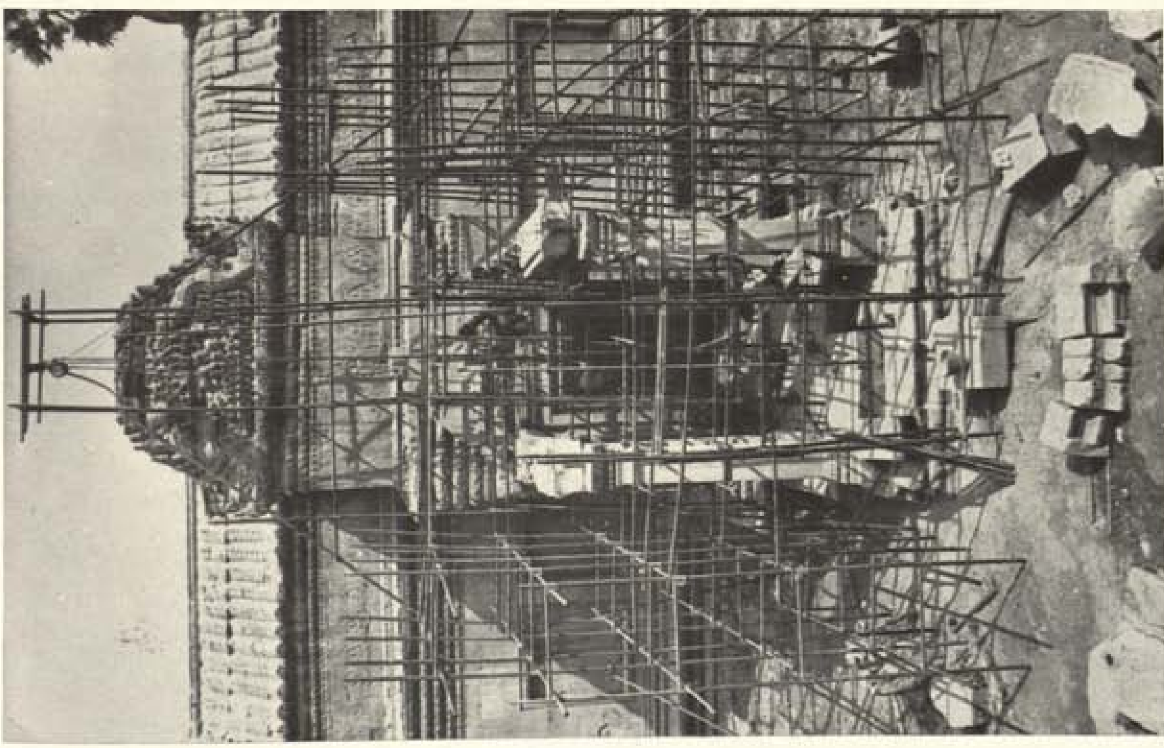


A

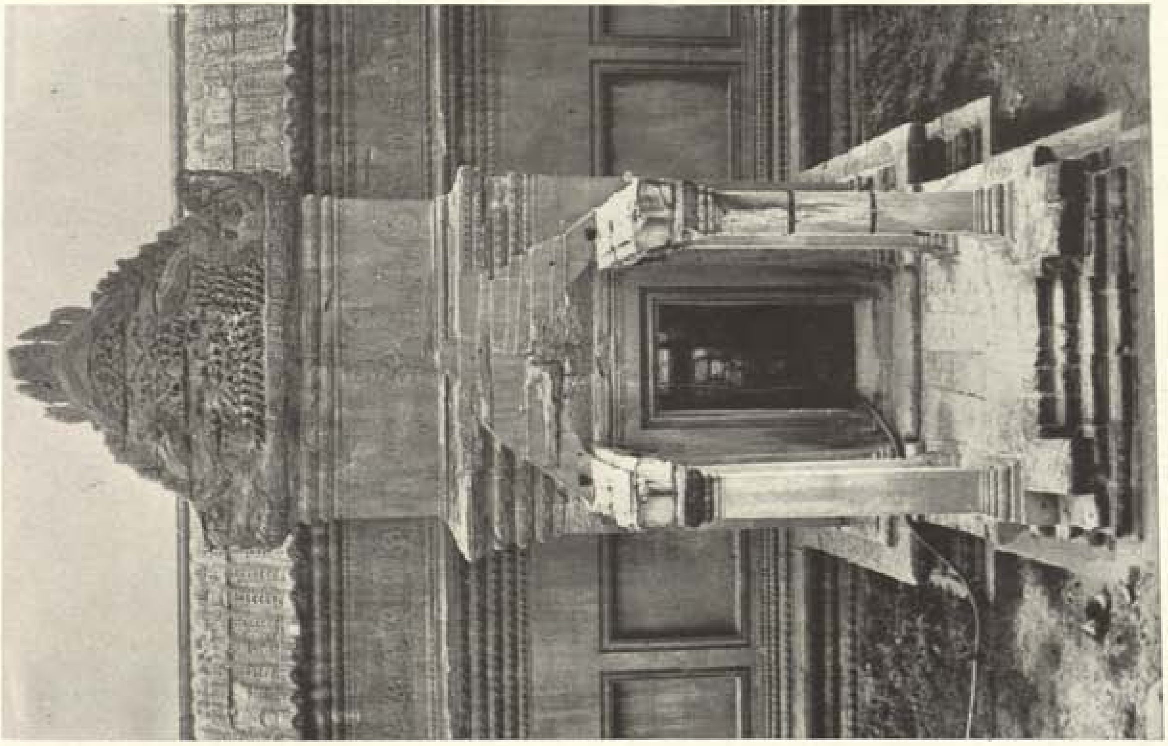


B

Third Enclosure : central inner entrance porch on eastern side, A, before and B, after conservation



A



B

Third Enclosure : inner entrance porch on northern side, A, *during and* B, *after conservation*

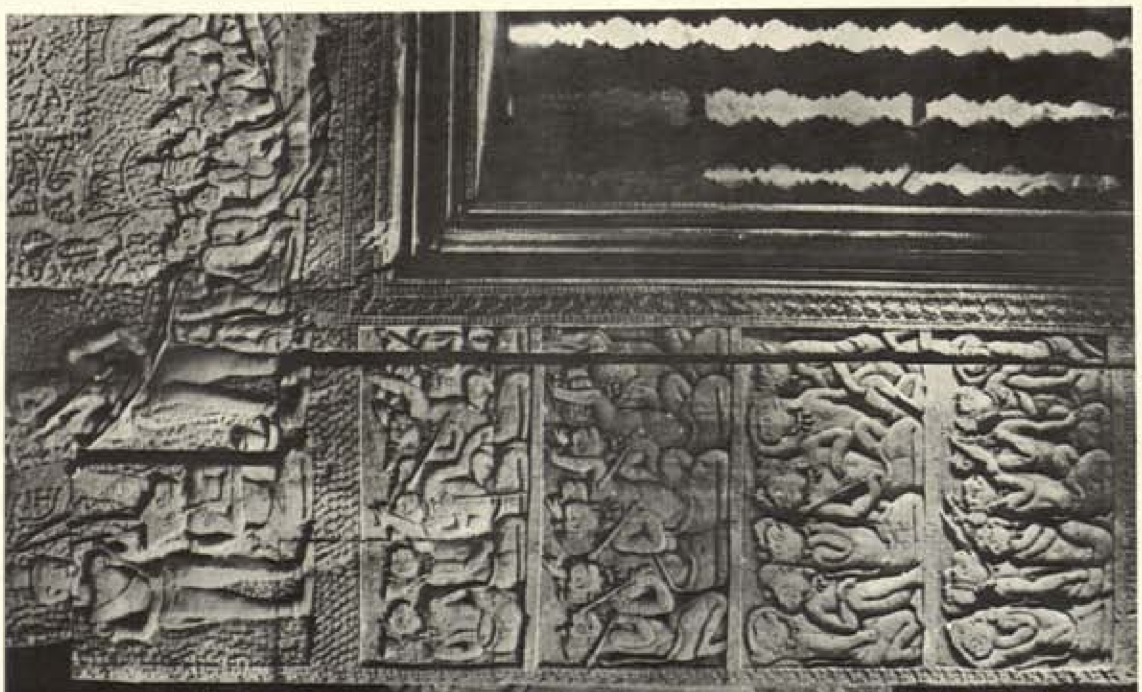


B

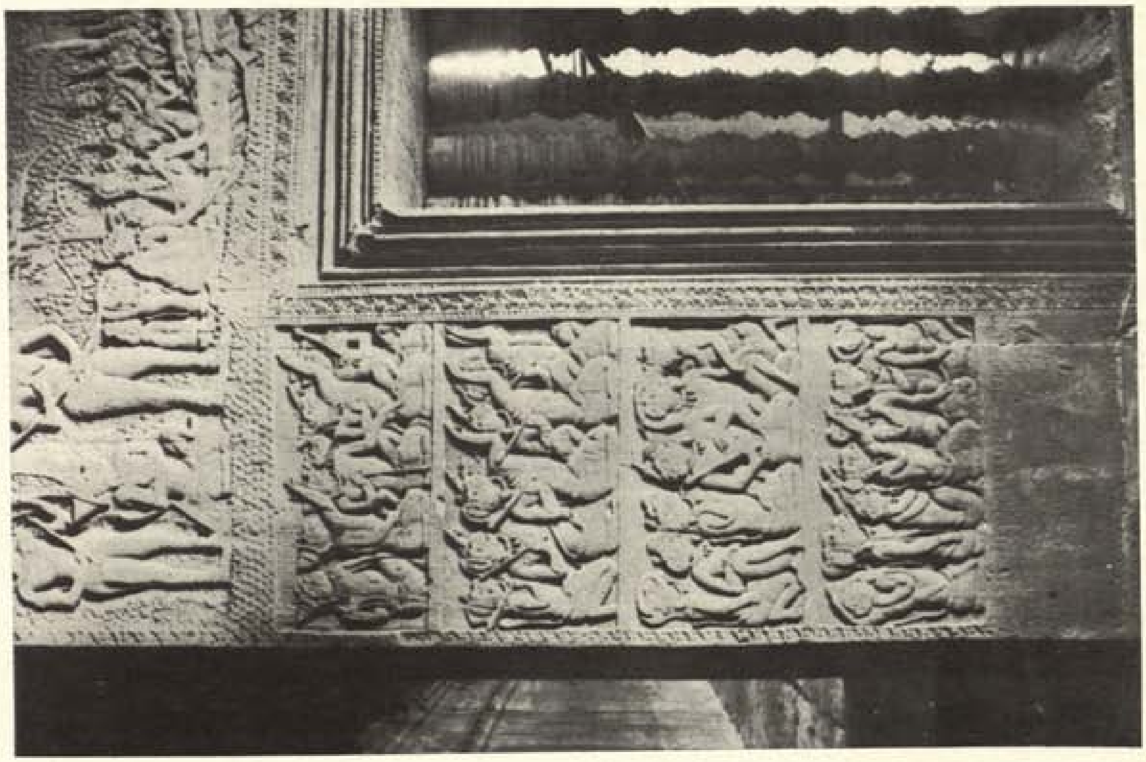


A

Third Enclosure : south-western corner entrance pavilion, A, before and B, after conservation



A



B

Third Enclosure : south-western corner entrance pavilion, A, before and B, after conservation



A

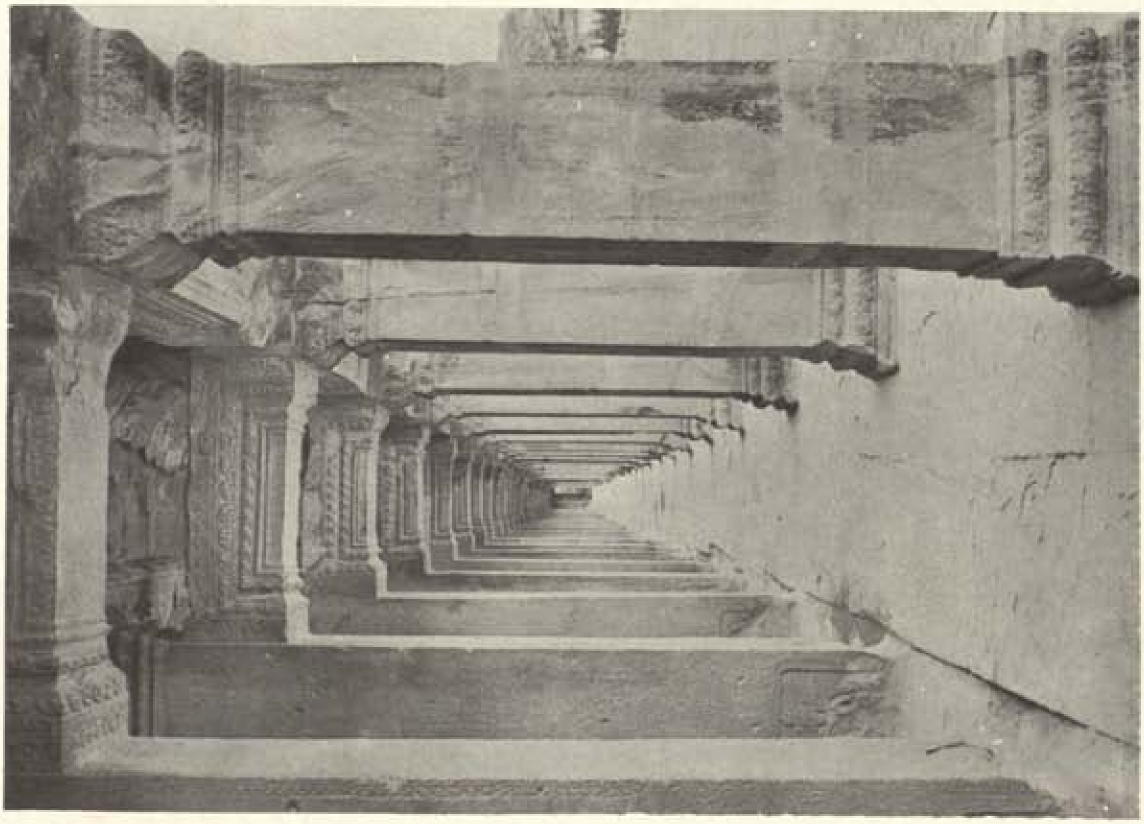


B

Third Enclosure : south-western corner entrance pavilion, A, *before and* B, *after conservation*

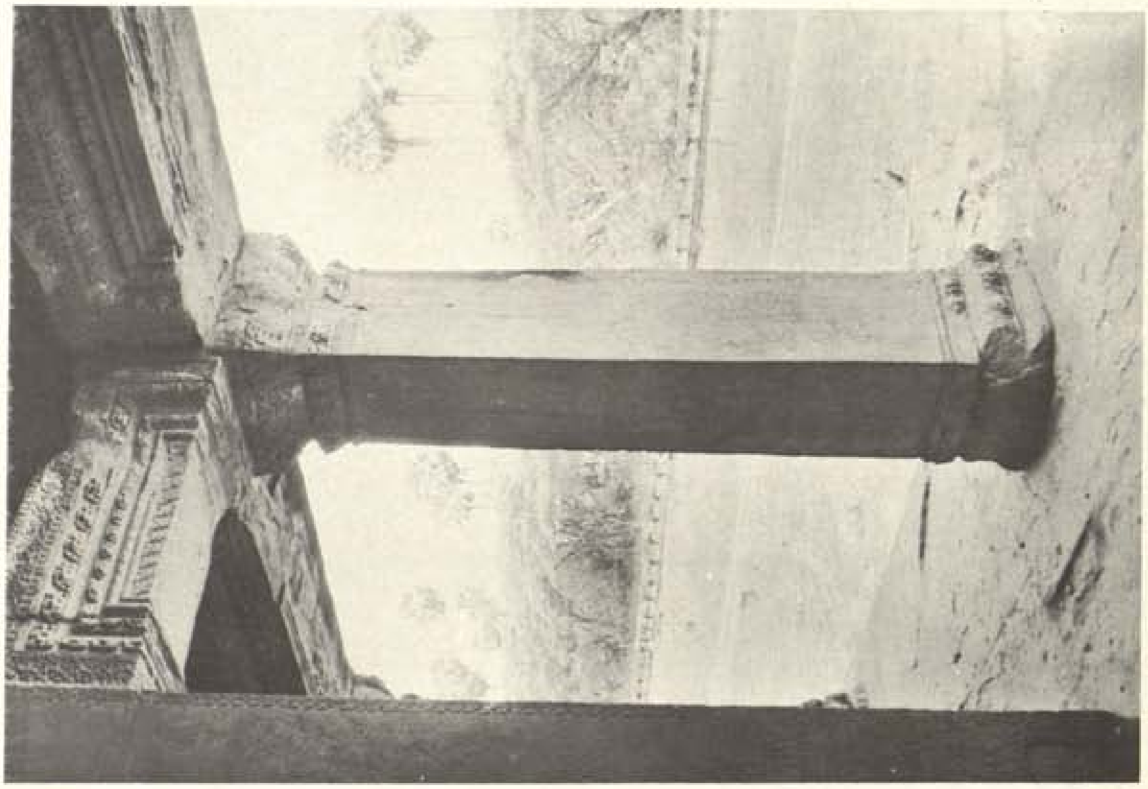


A



B

Third Enclosure : Western Gallery, A, before and B, after conservation



B



A

Third Enclosure : Western Gallery. A, before and B, after conservation



B

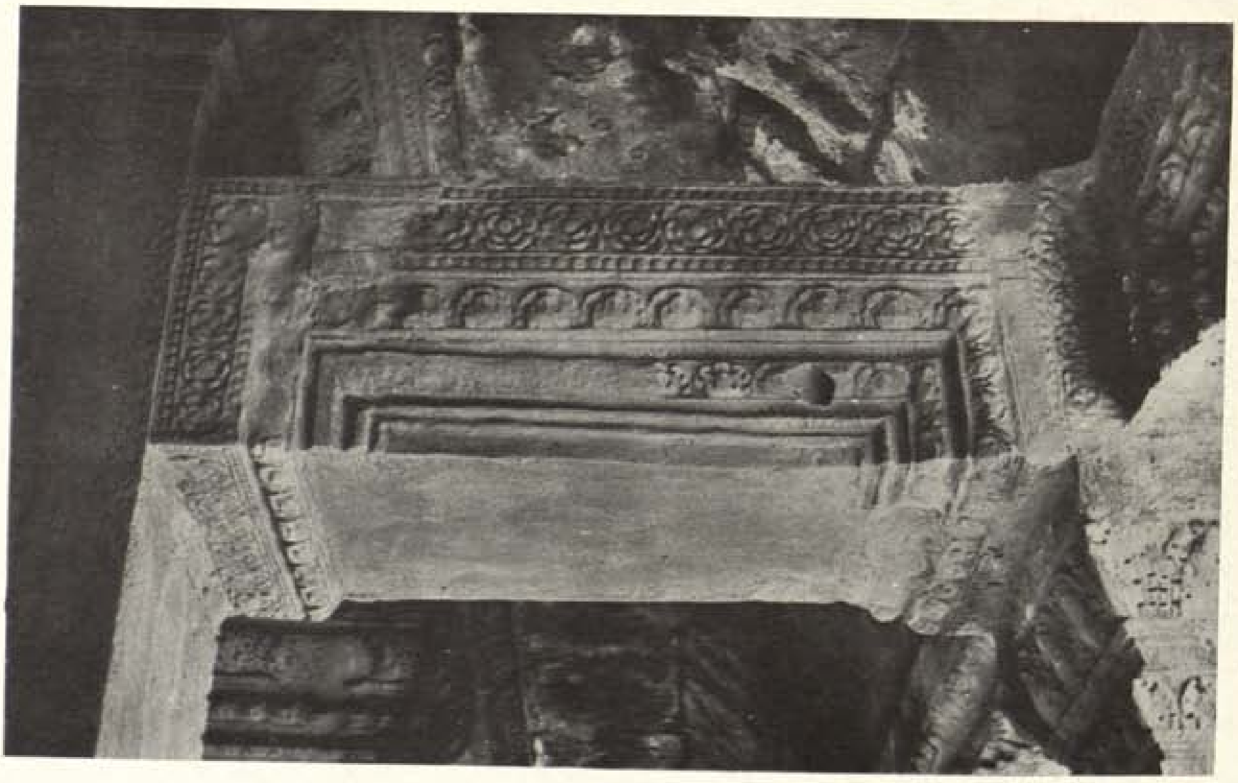


A

Third Enclosure : Western Gallery, A, before and B, after conservation



A



B

Third Enclosure : *Eastern Gallery*, A, *before and* B, *after conservation*

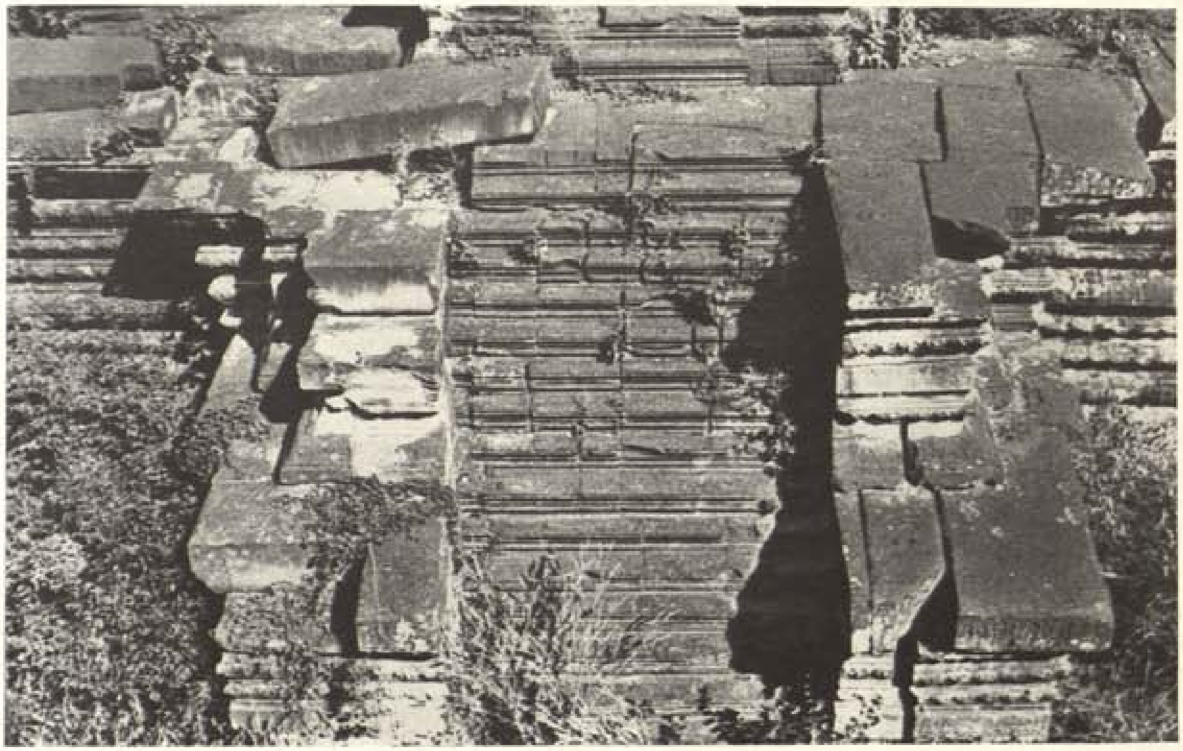


A



B

Third Enclosure : *Eastern Gallery*, A, *before and* B, *after conservation*

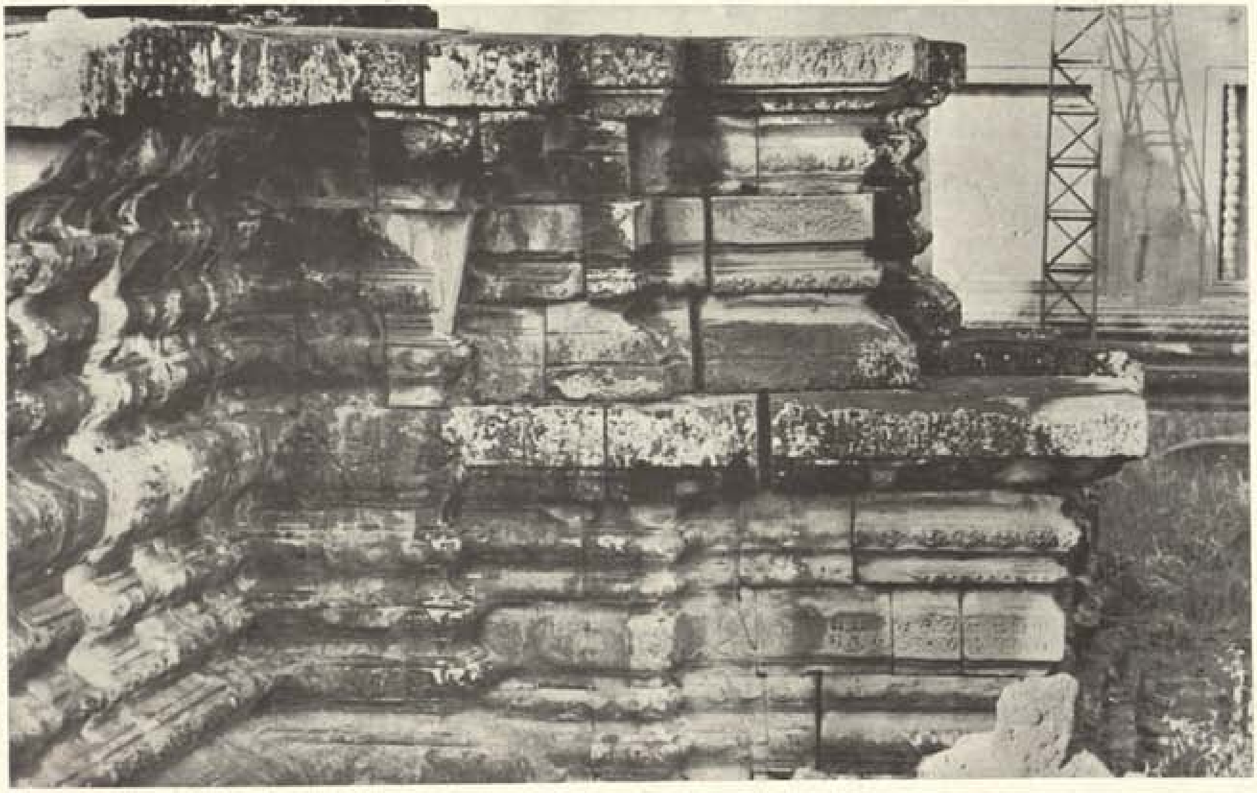


A

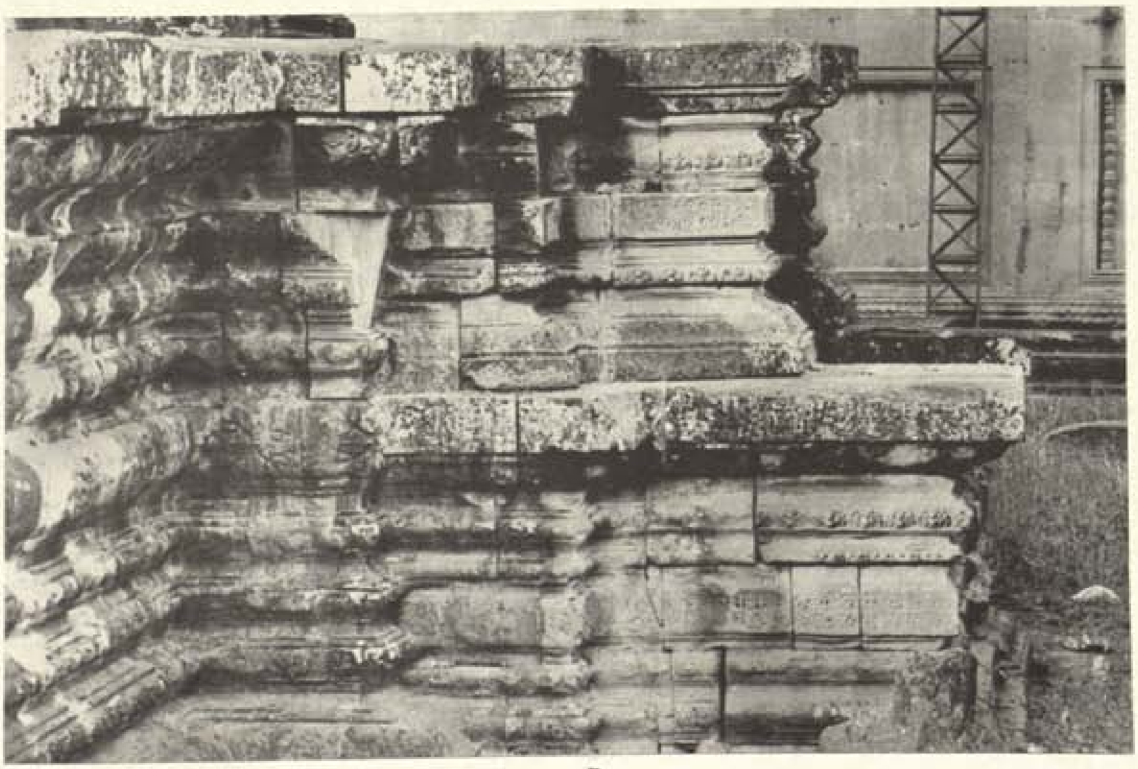


B

Southern Library between Second and Third Enclosures : southern stepped entrance, A, before and B, after conservation



A

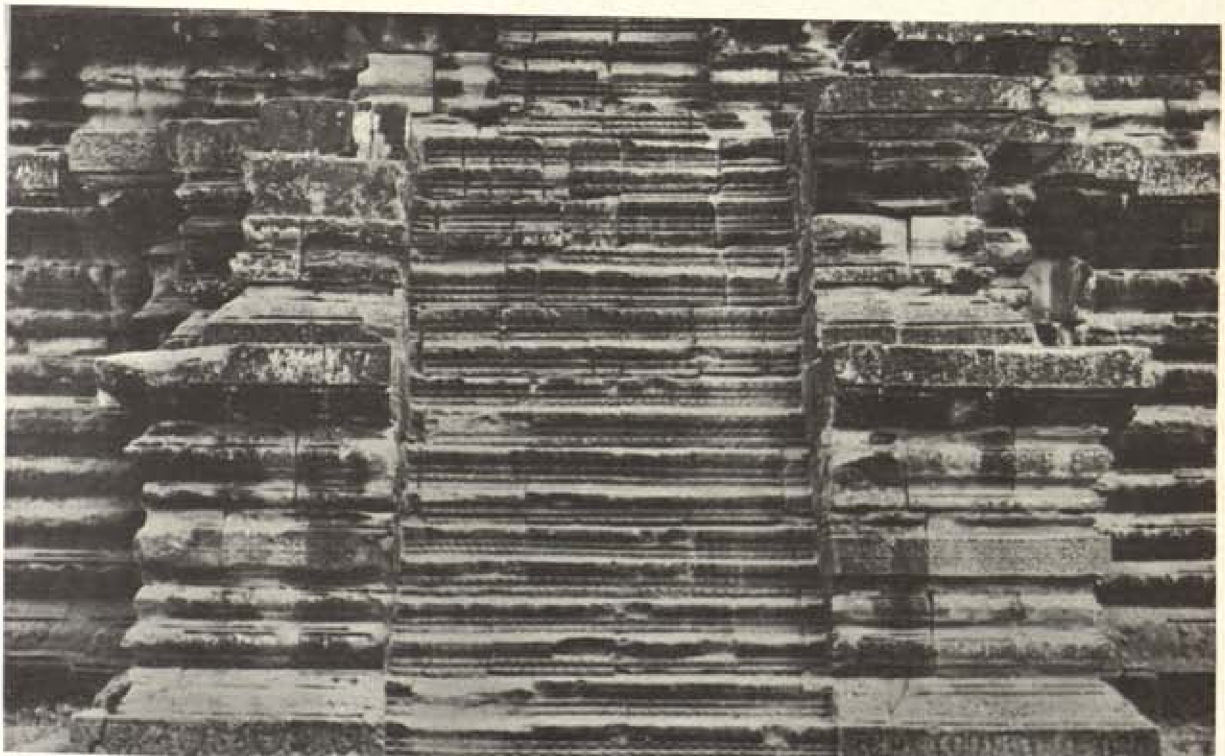


B

Southern Library between Second and Third Enclosures : northern stepped entrance, A, before and B, after conservation

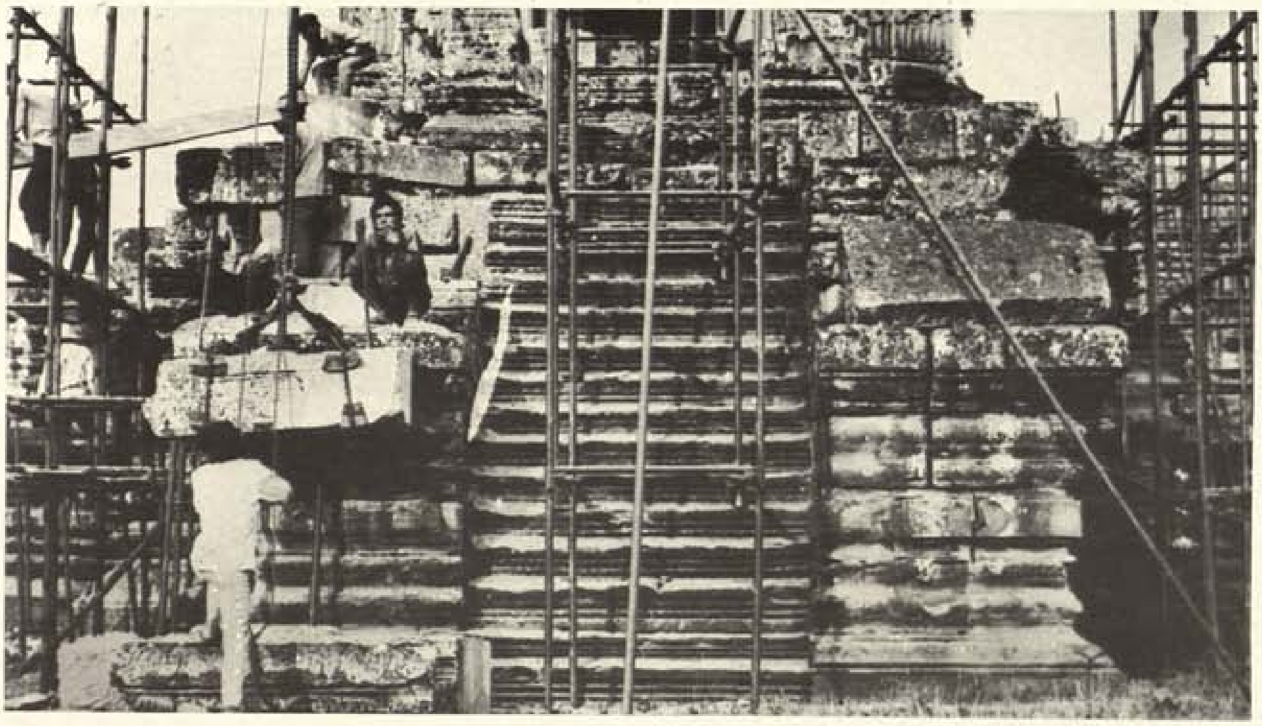


A

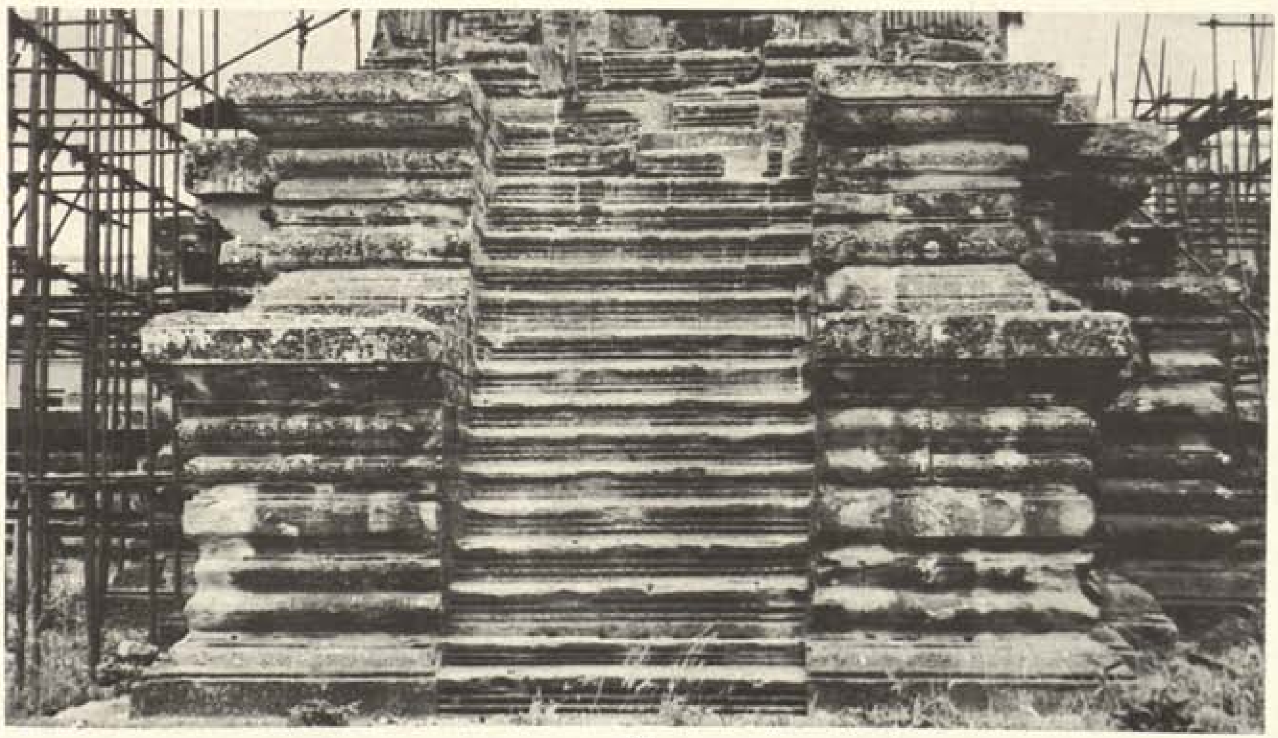


B

Northern Library between Second and Third Enclosures : southern stepped entrance,
A, before and B, after conservation

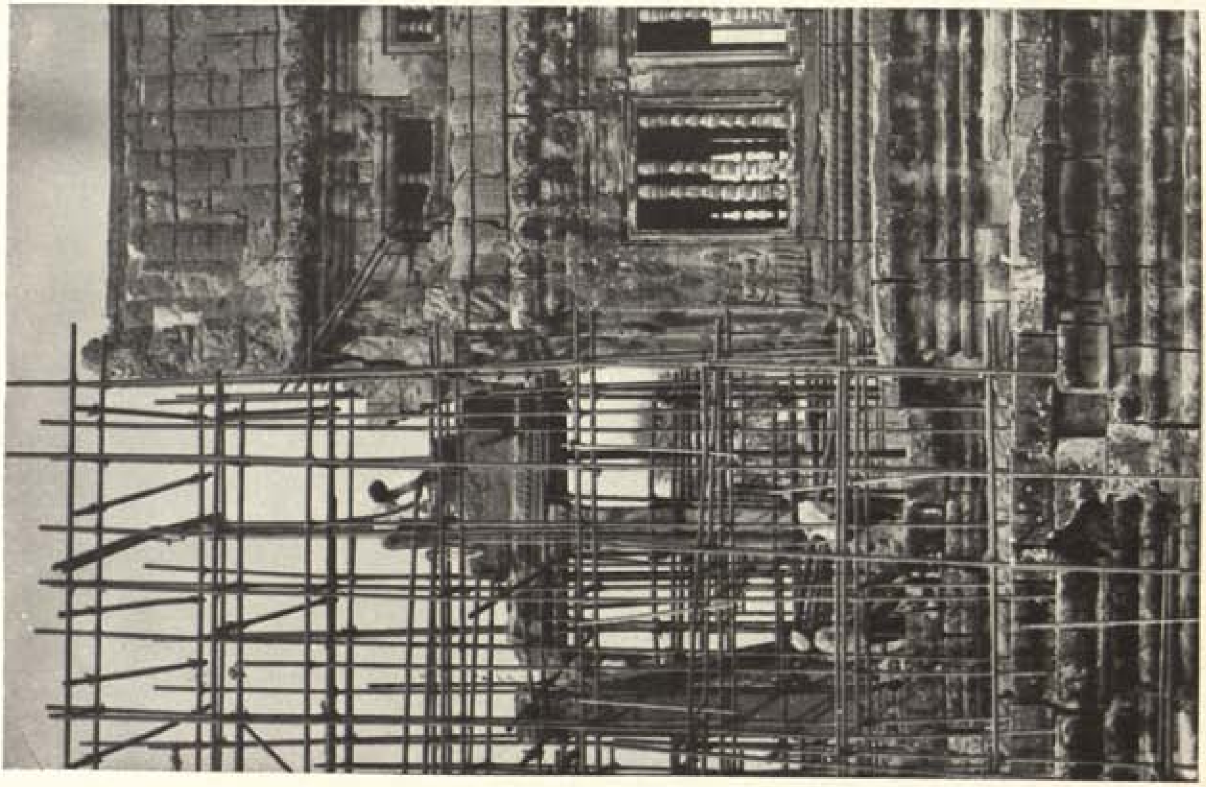


A

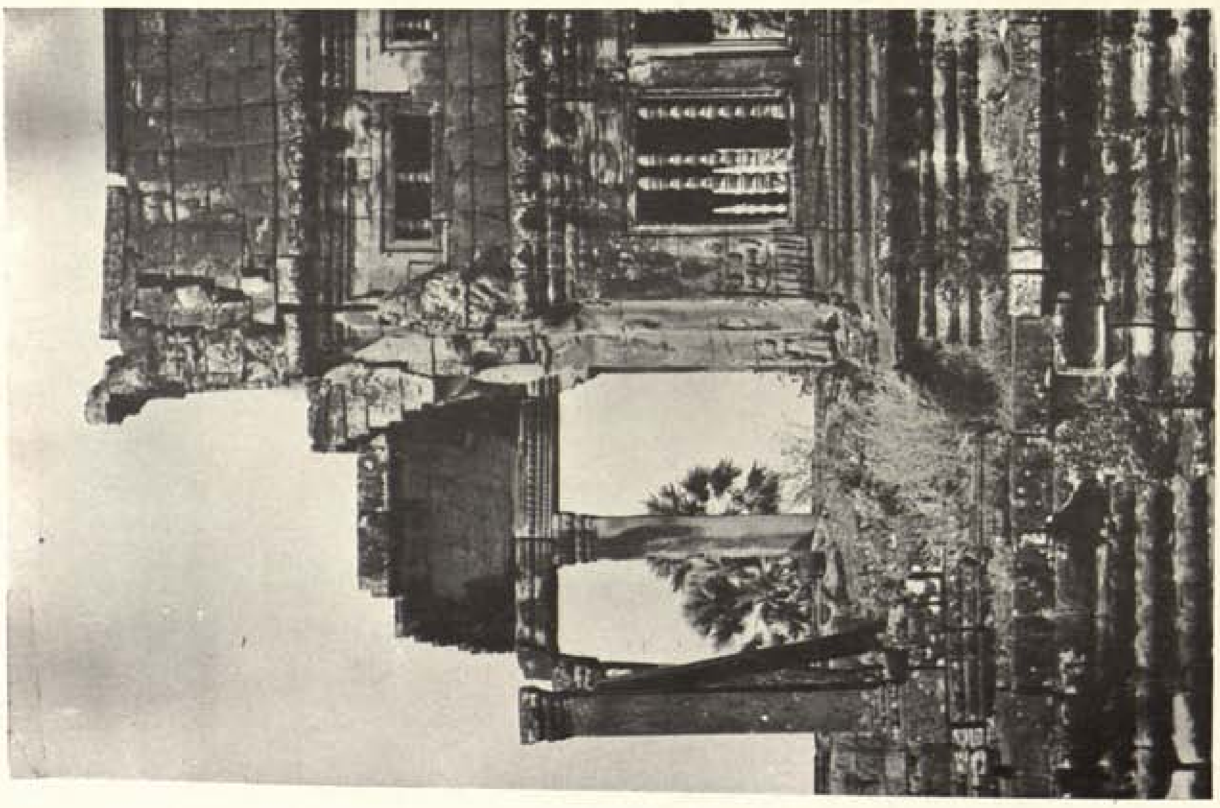


B

Northern Library between Second and Third Enclosures : eastern stepped entrance,
A, *during and* B, *after conservation*

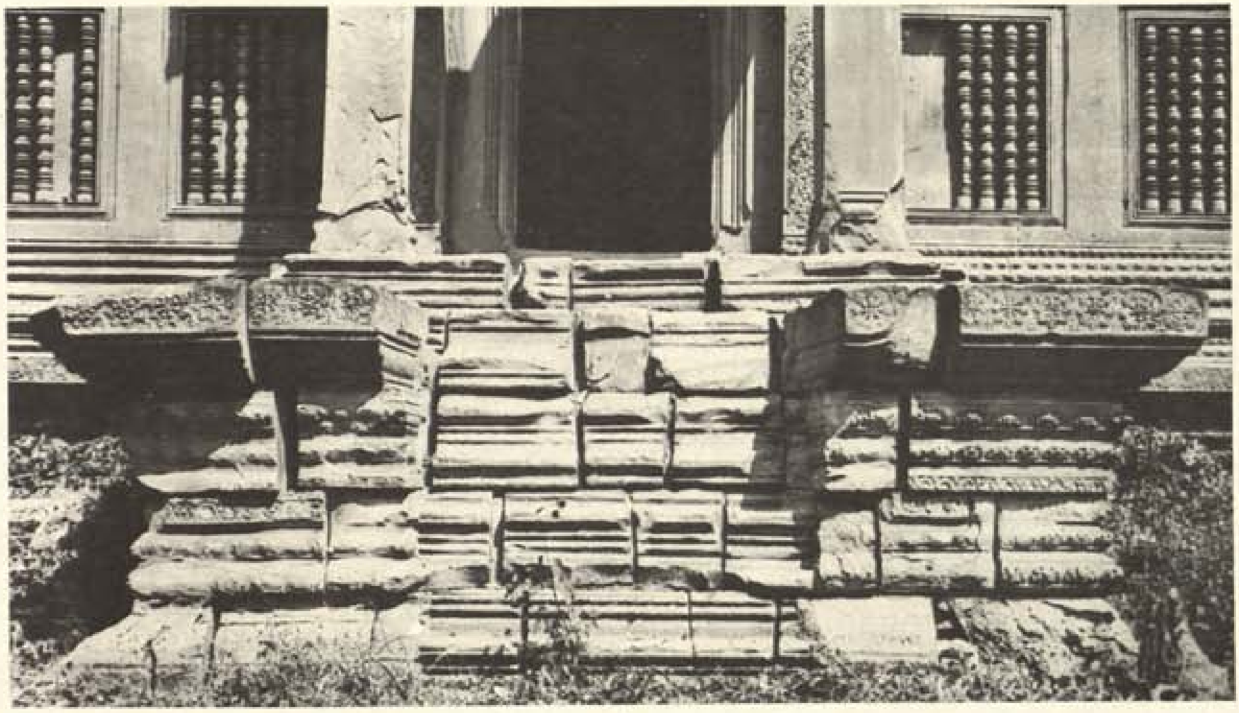


B



A

Northern Library between Second and Third Enclosures : western topmost torana, A, *before and* B, *after conservation*



A



B

Antechamber between Second and Third Enclosures: southern stepped entrance,
A, *before and* B, *after conservation*

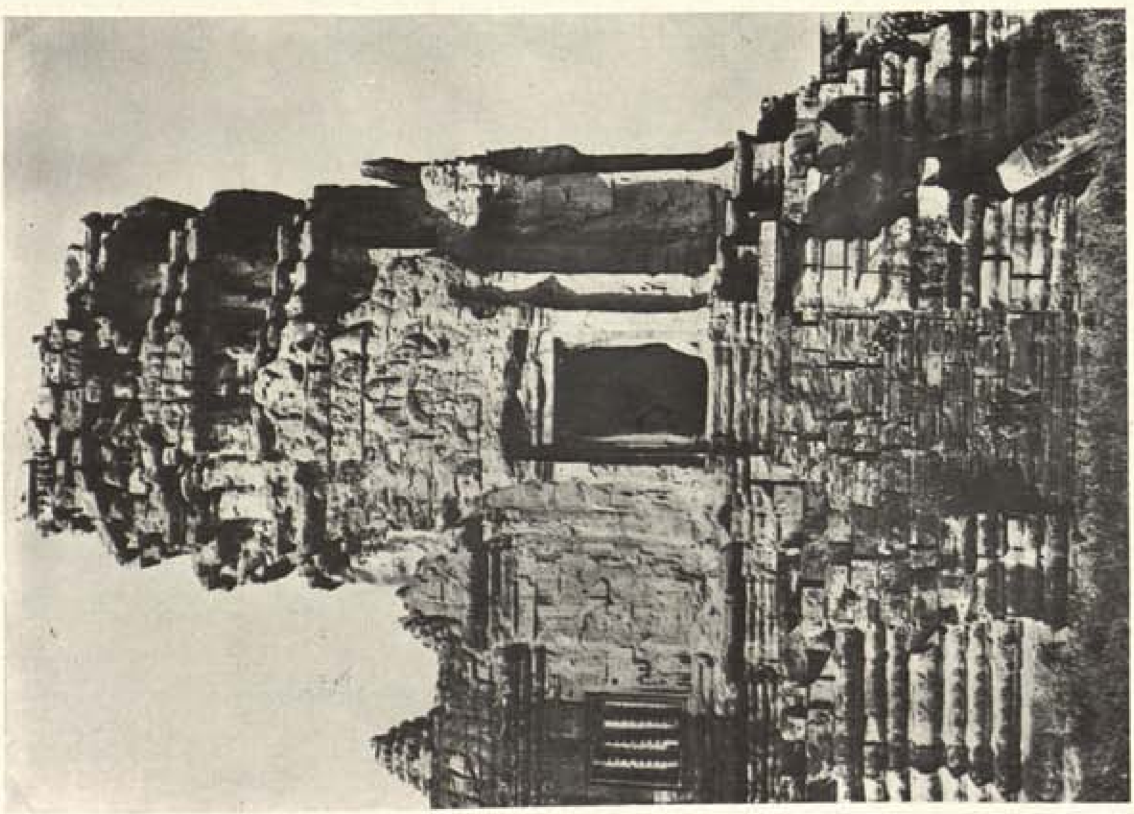


B

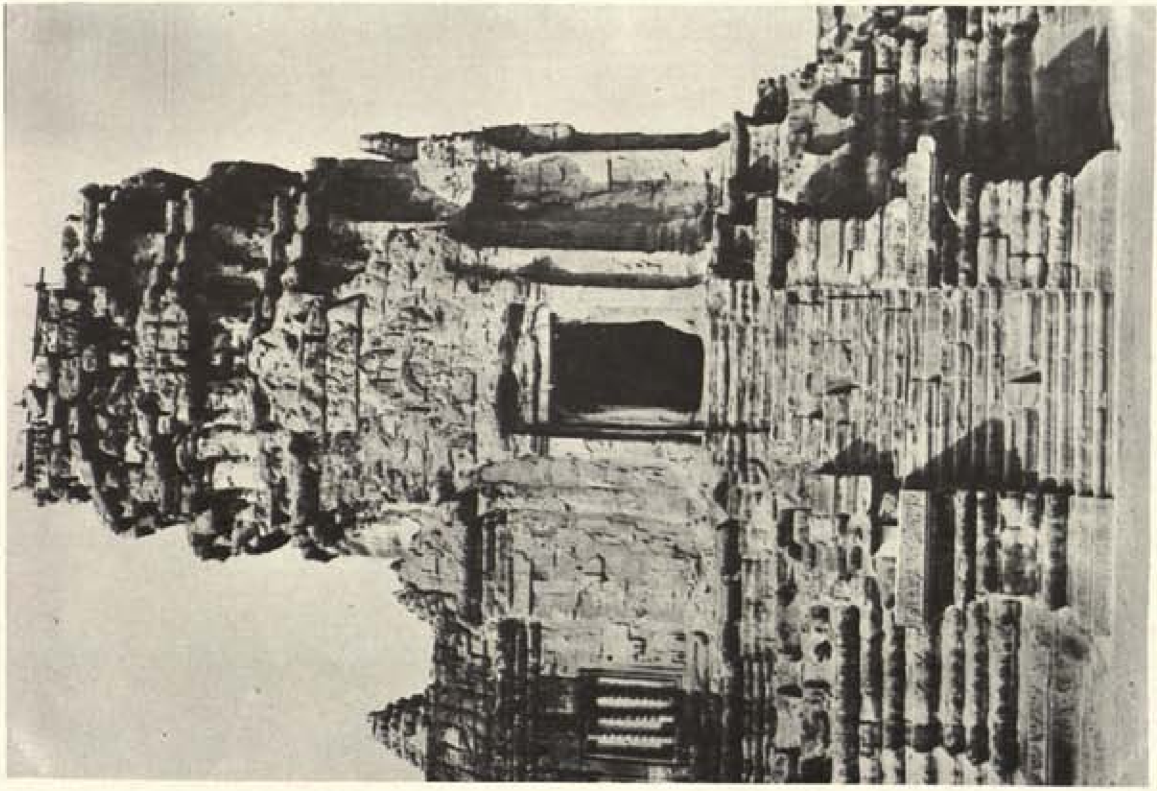


A

Antechamber between Second and Third Enclosures: Southern Gallery, A, before and B, after conservation



A



B

Second Enclosure : eastern stepped entrance at north corner, A, before and B, after conservation

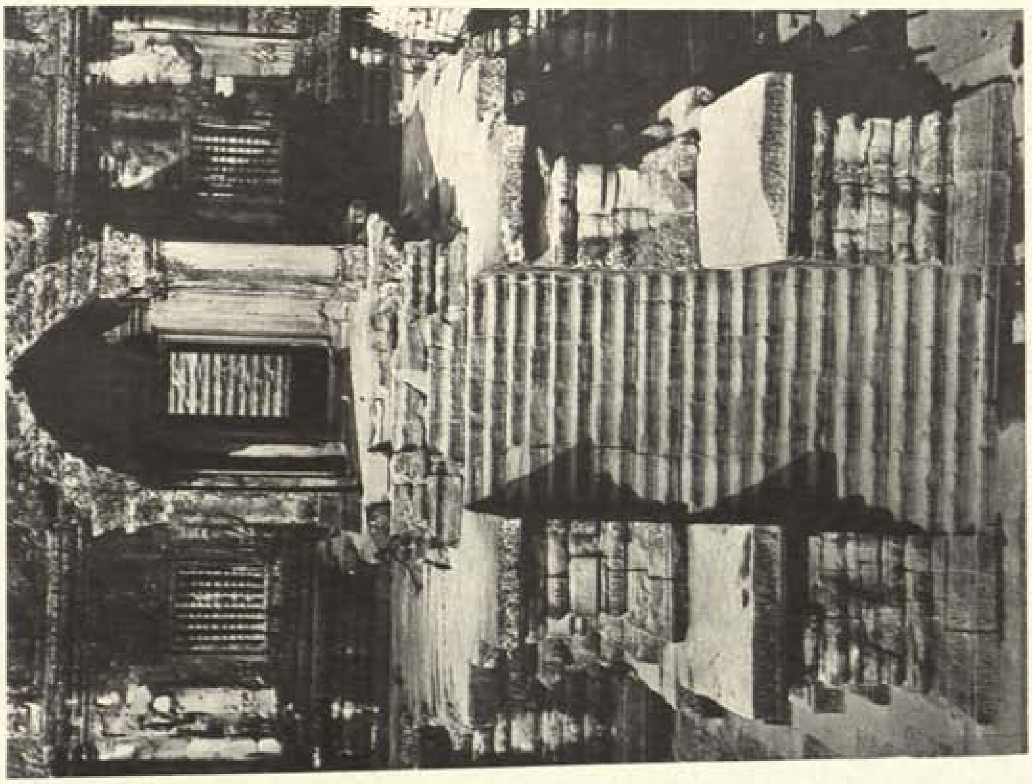


A

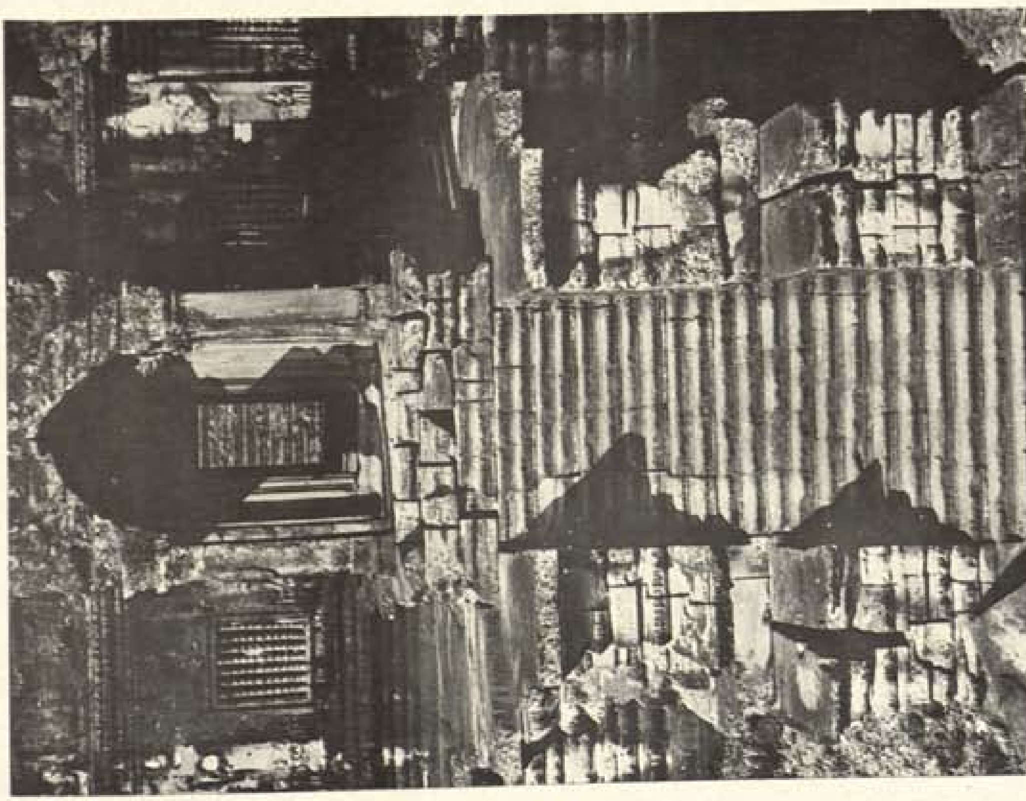


B

Second Enclosure : *eastern stepped entrance at north corner*, A, *before and* B, *after conservation*

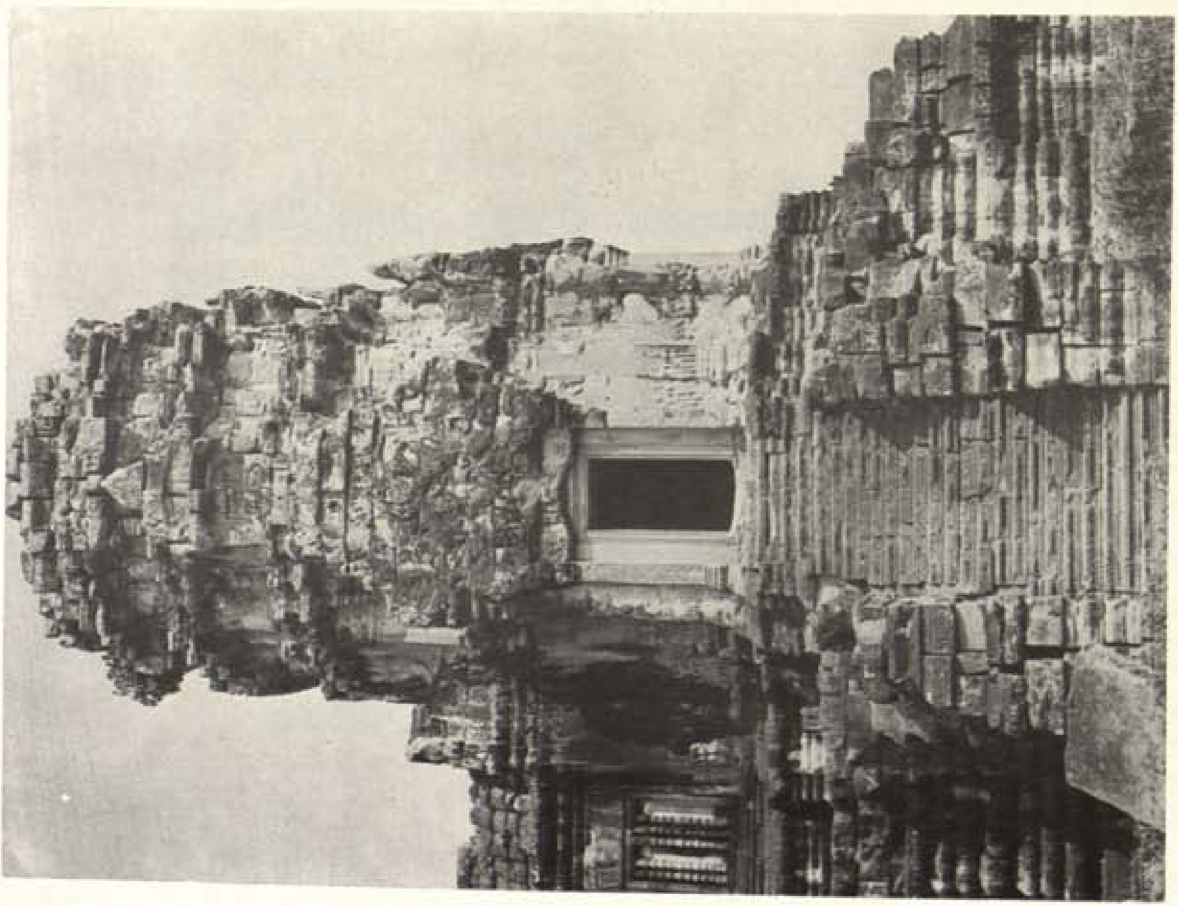


B

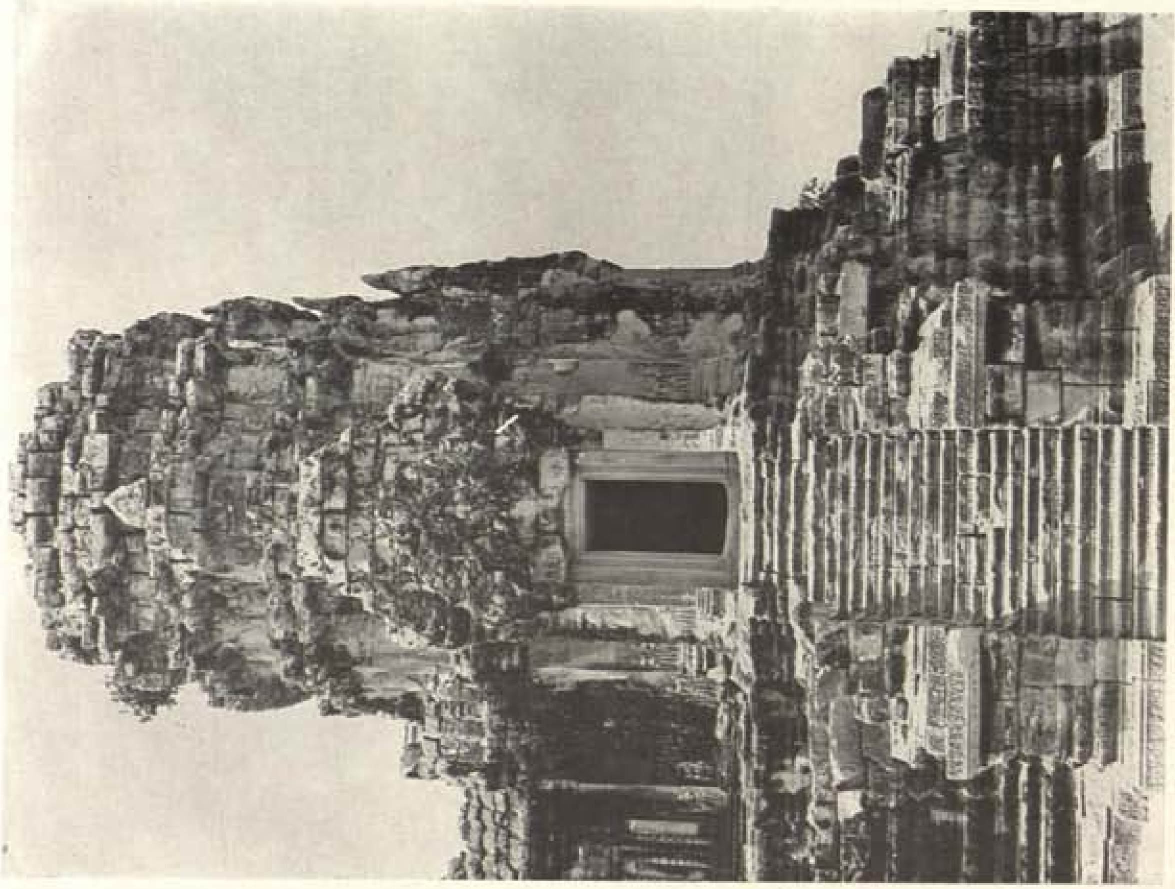


A

Second Enclosure : eastern central entrance , A, *before and* B, *after conservation*

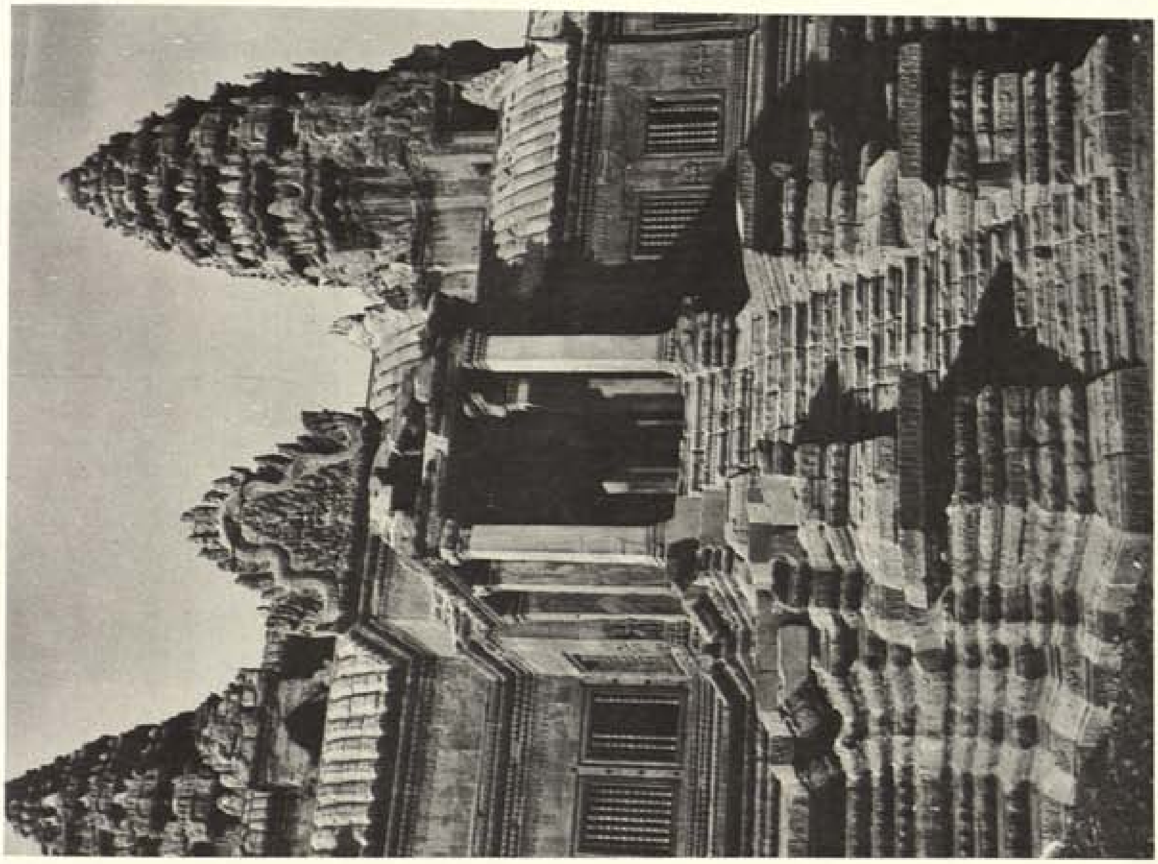


A

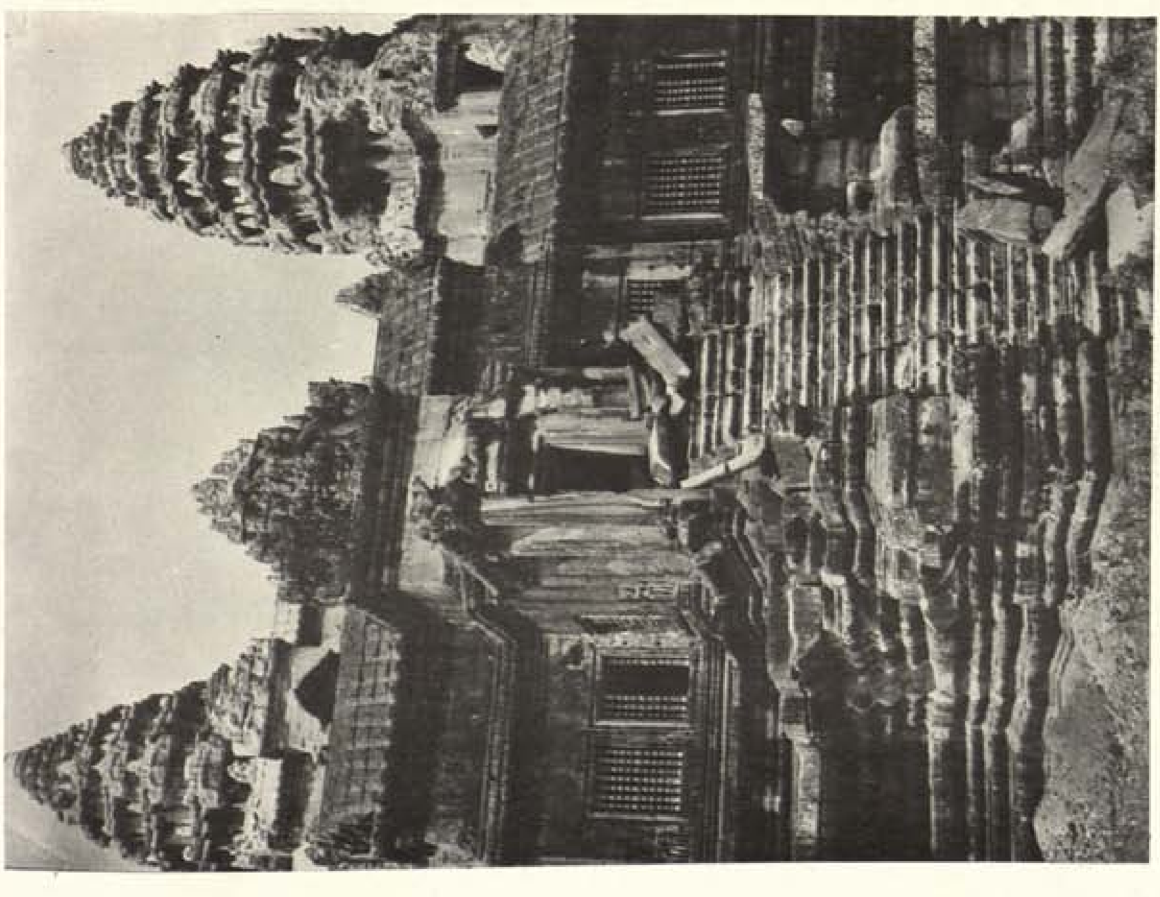


B

Second Enclosure : southern entrance at east corner, A, before and B, after conservation

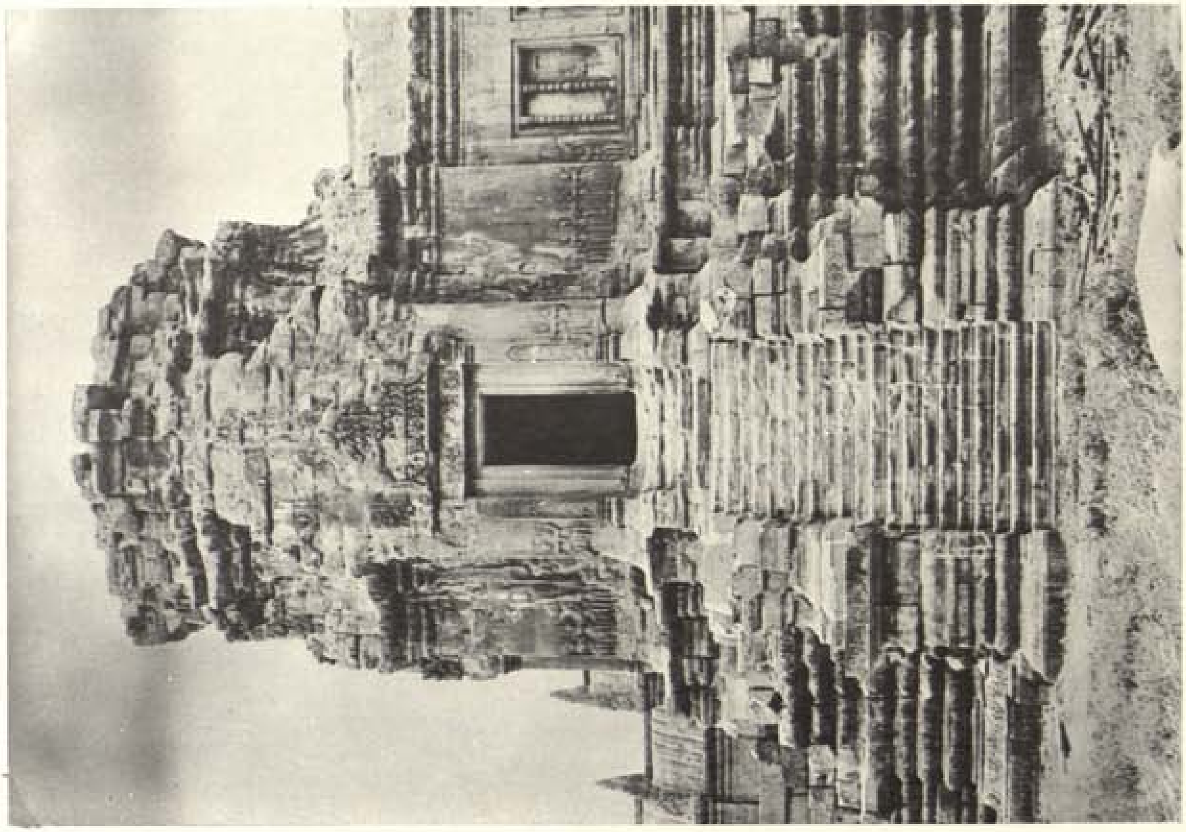


B

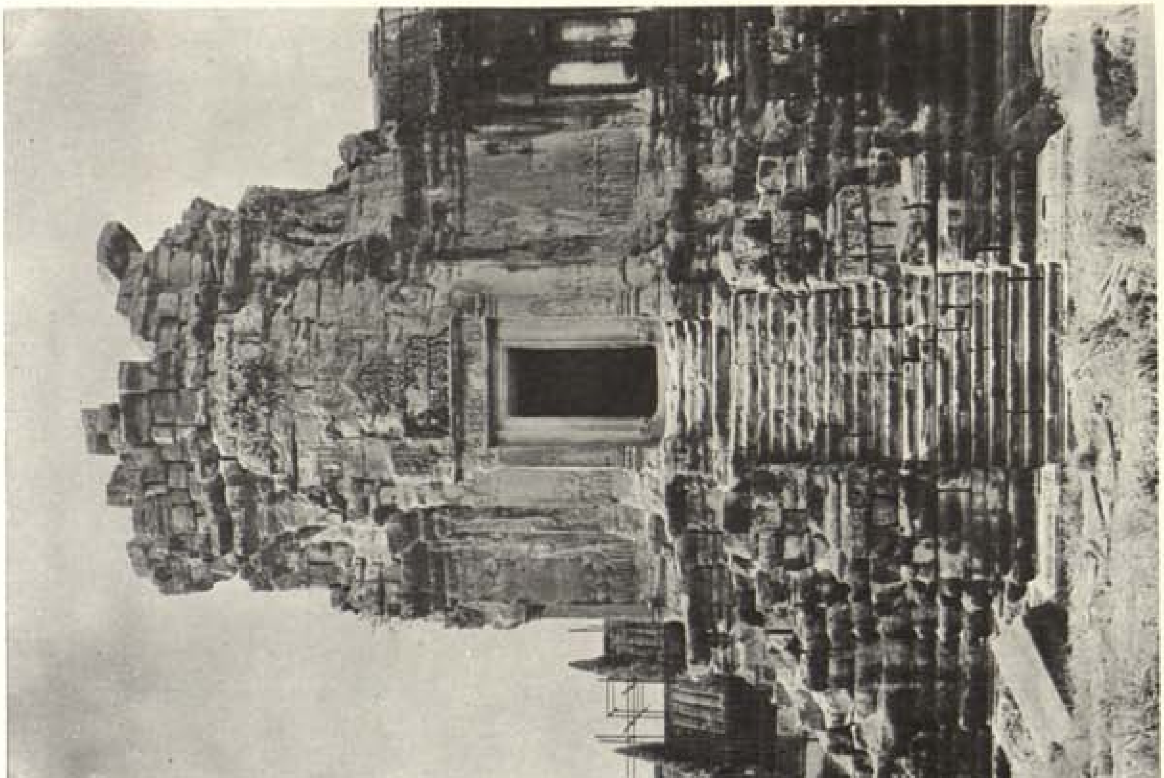


A

Second Enclosure : southern central entrance, A, before and B, after conservation

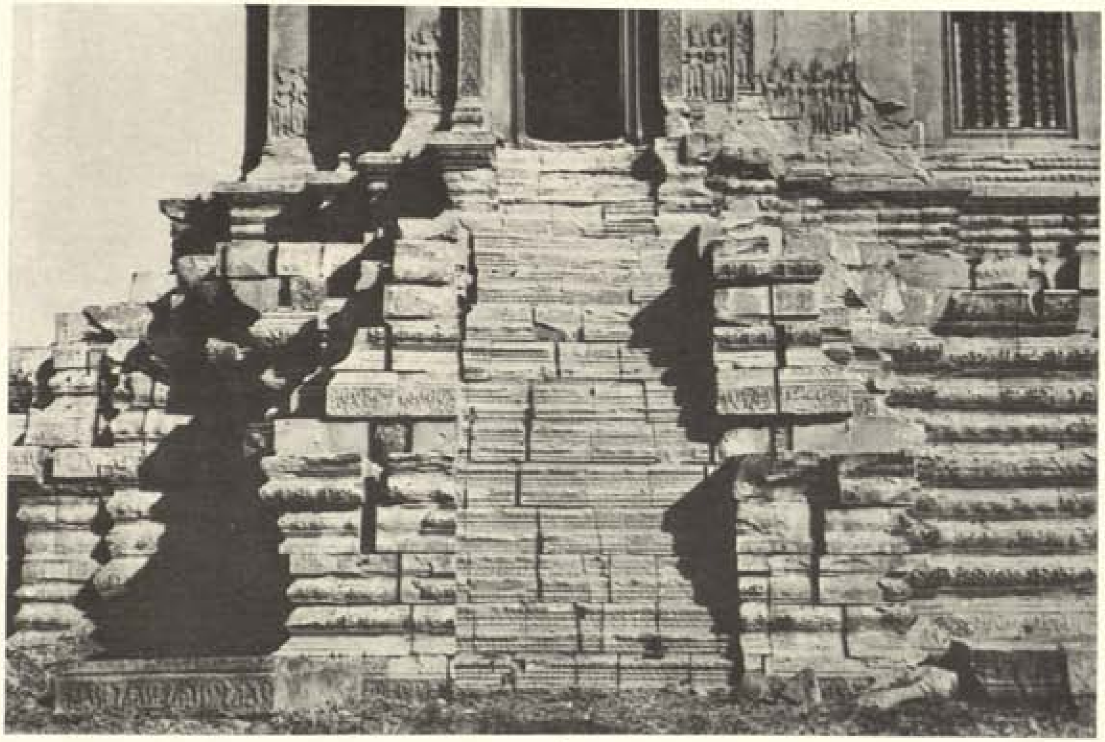


B



A

Second Enclosure : southern entrance at west corner, A, before and B, after conservation



A

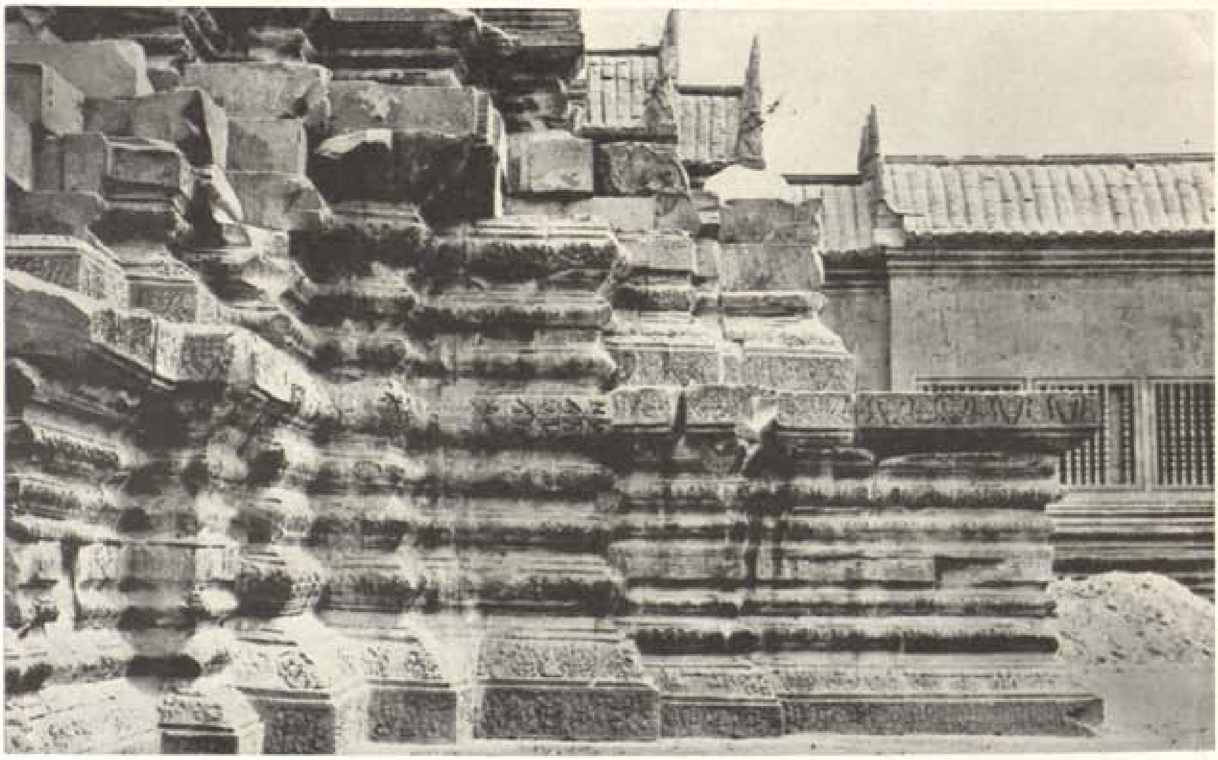


B

Second Enclosure : *western entrance at south corner*, A, *before and* B, *after conservation*

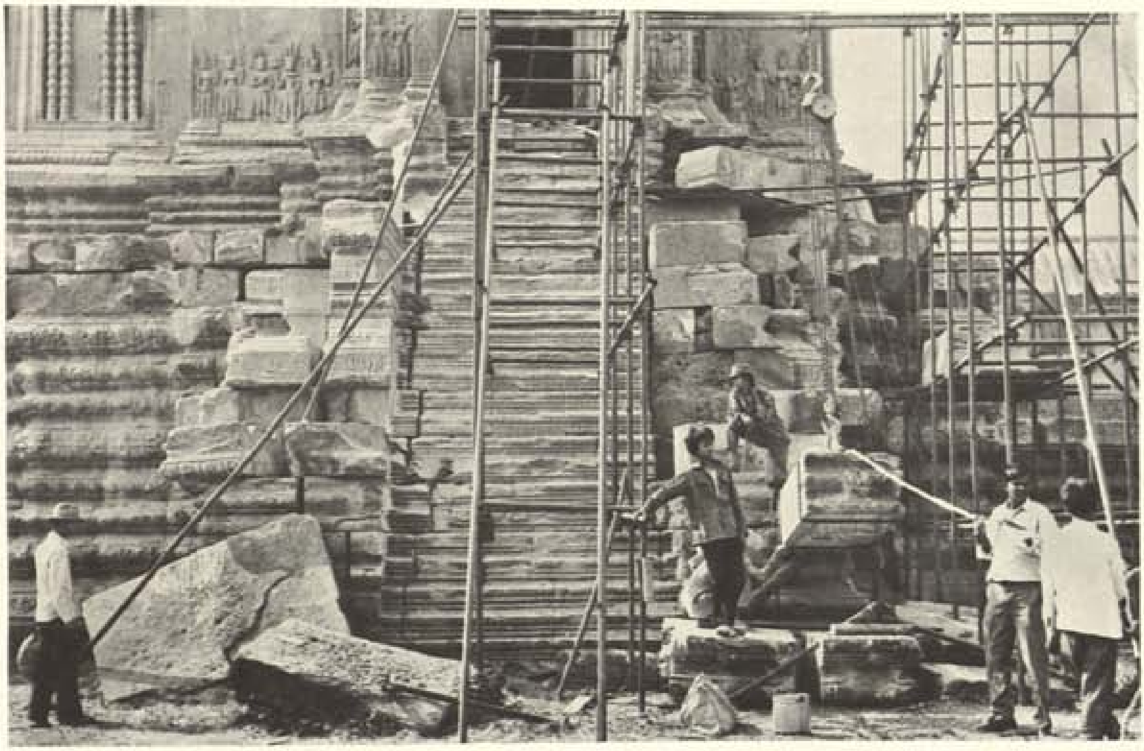


A



B

Second Enclosure : western entrance at north corner, A, *before and* B, *after conservation*

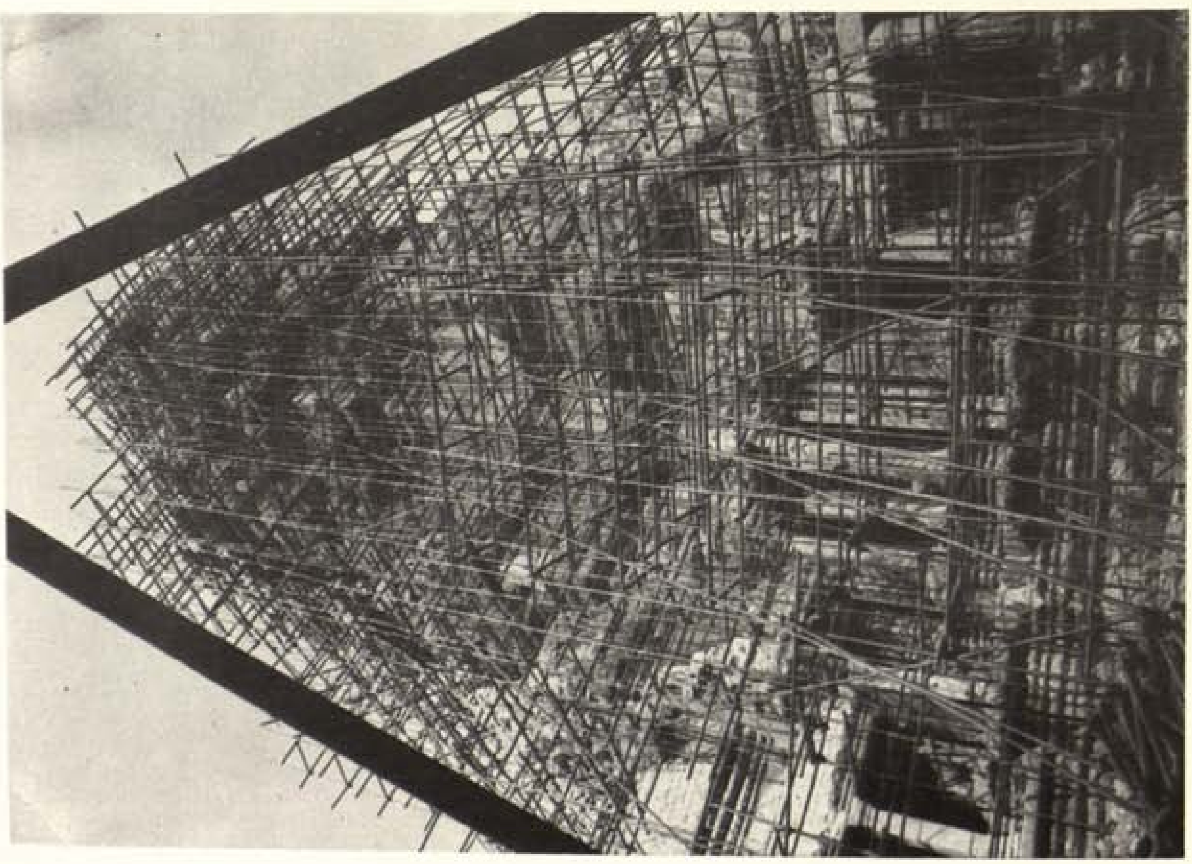


A

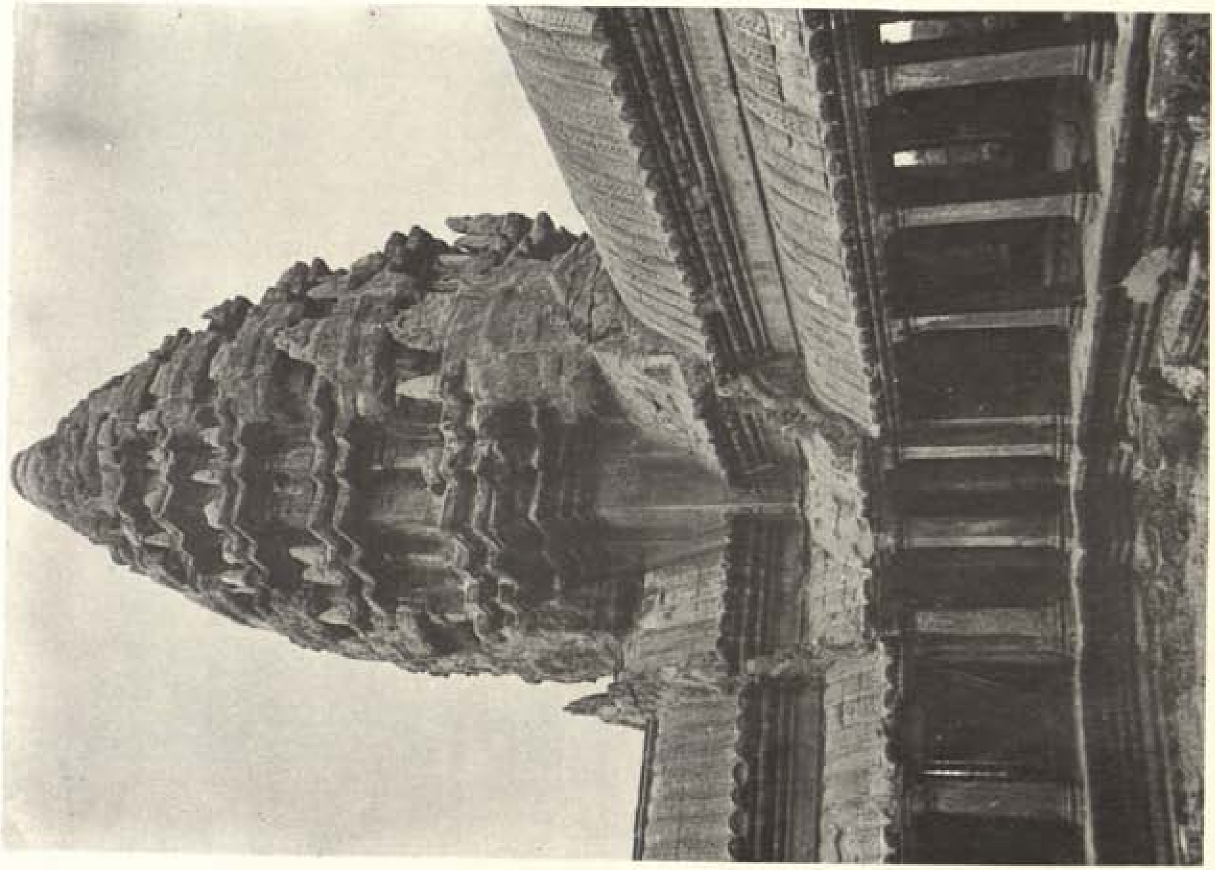


B

Second Enclosure : northern entrance at west corner, A, *before and* B, *after conservation*

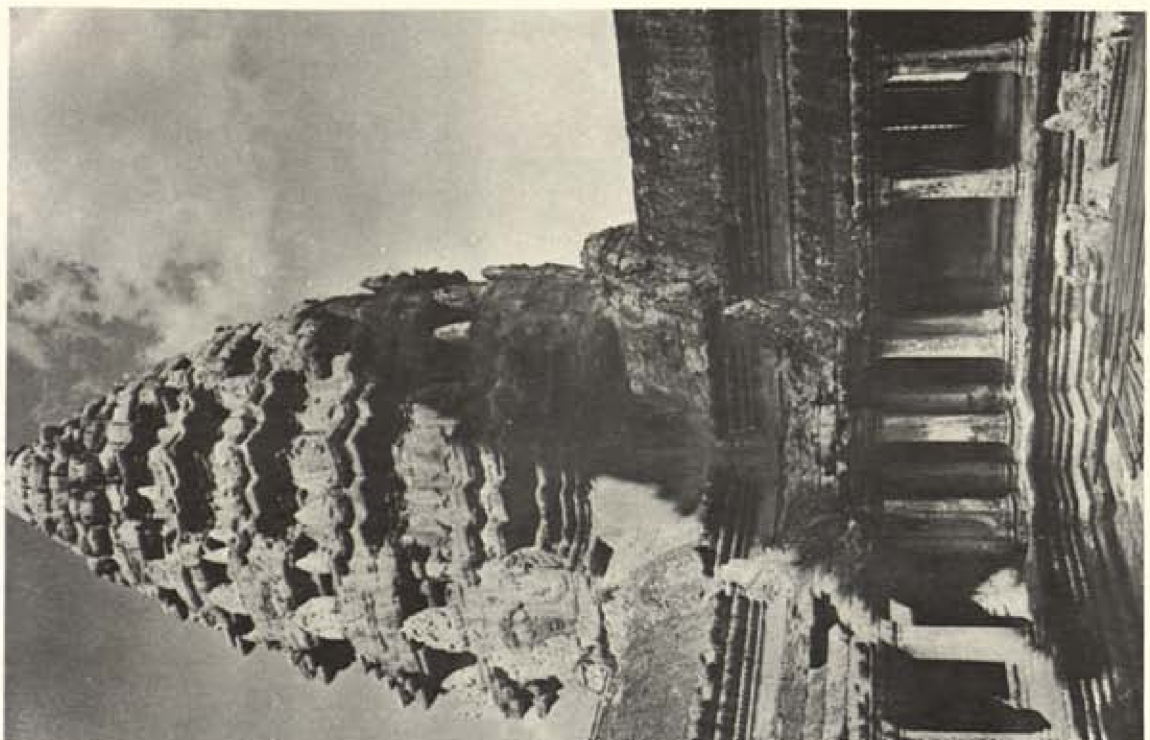


A

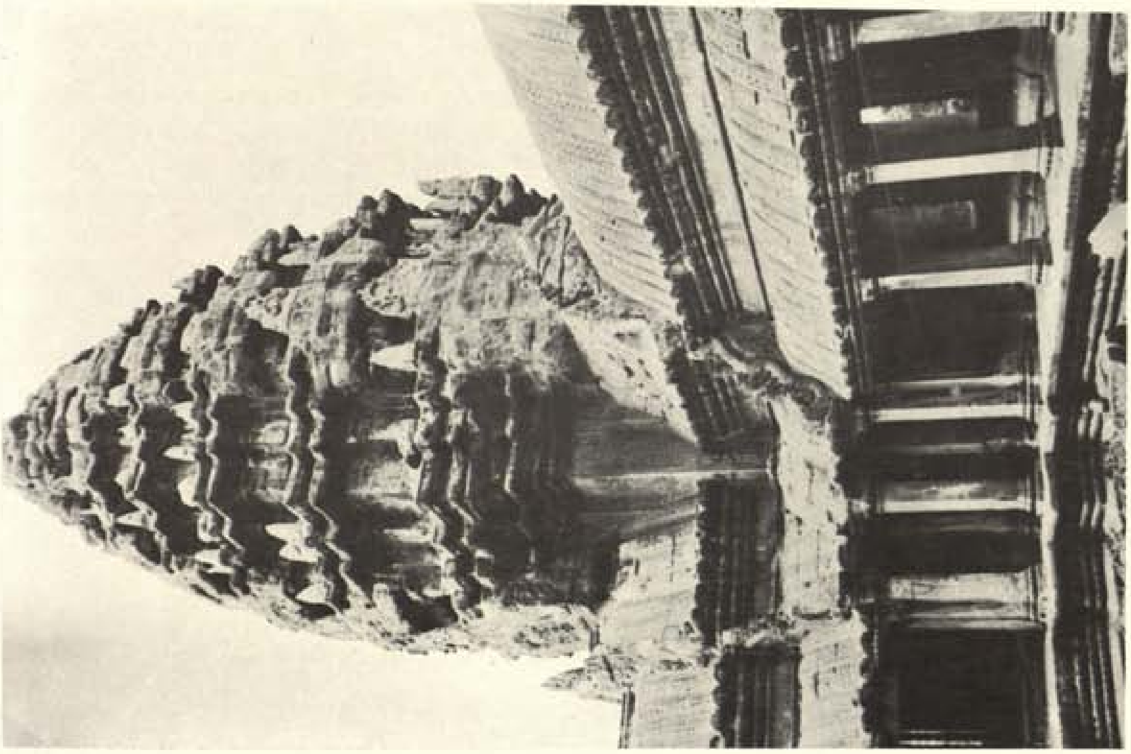


B

First Enclosure : central tower, A, during and B, after conservation and chemical treatment

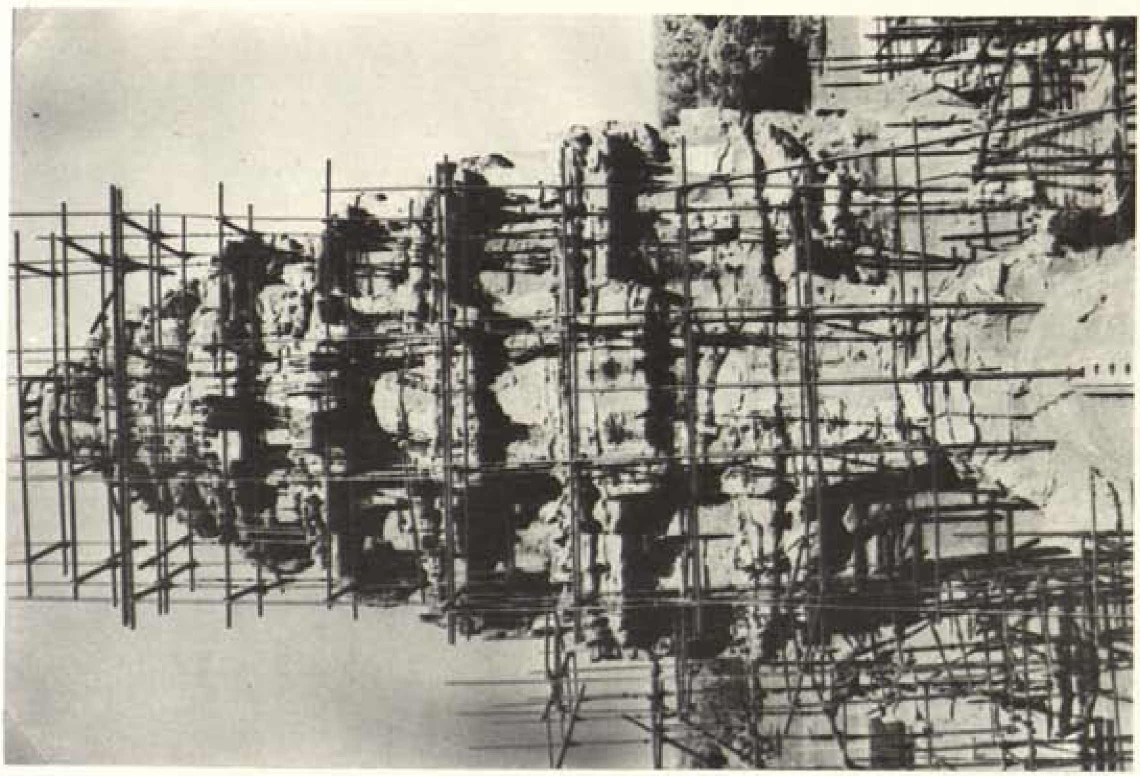


A

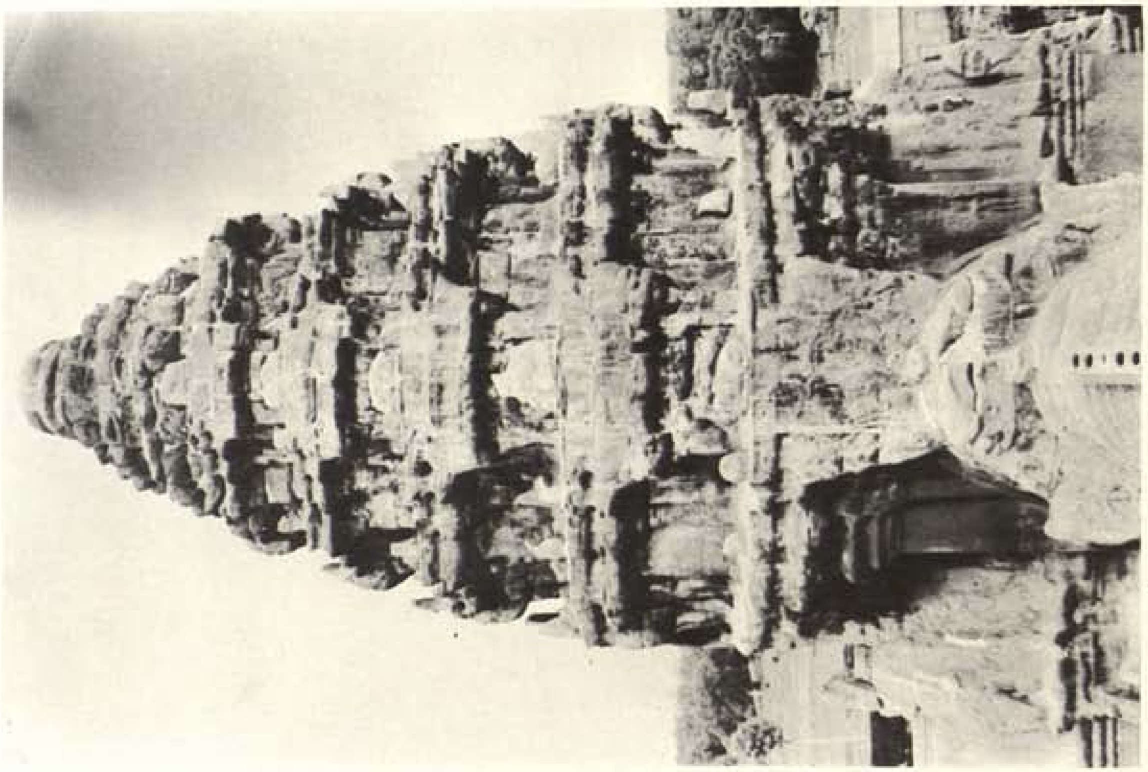


B

First Enclosure : north-east tower, A, before and B, after conservation and chemical treatment



A



B

First Enclosure : north-west corner tower, A, during and B, after conservation

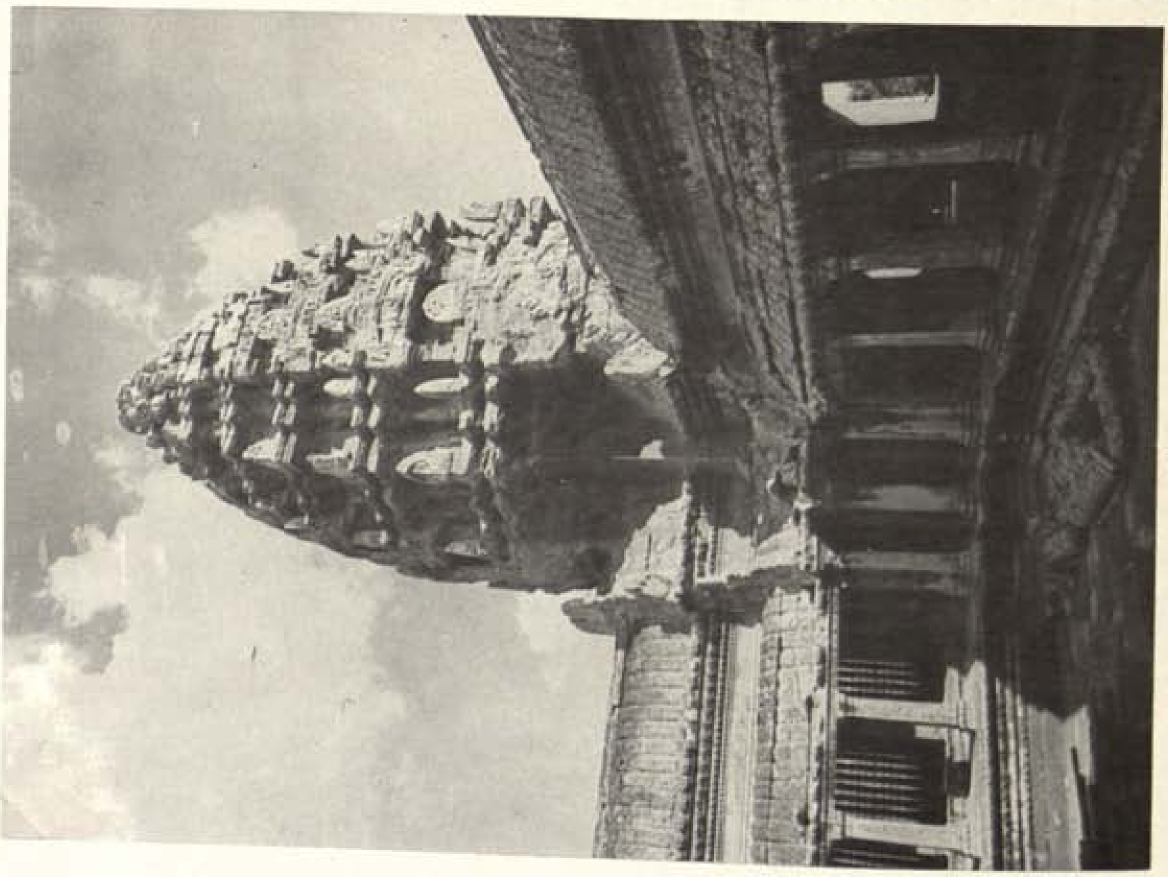


A

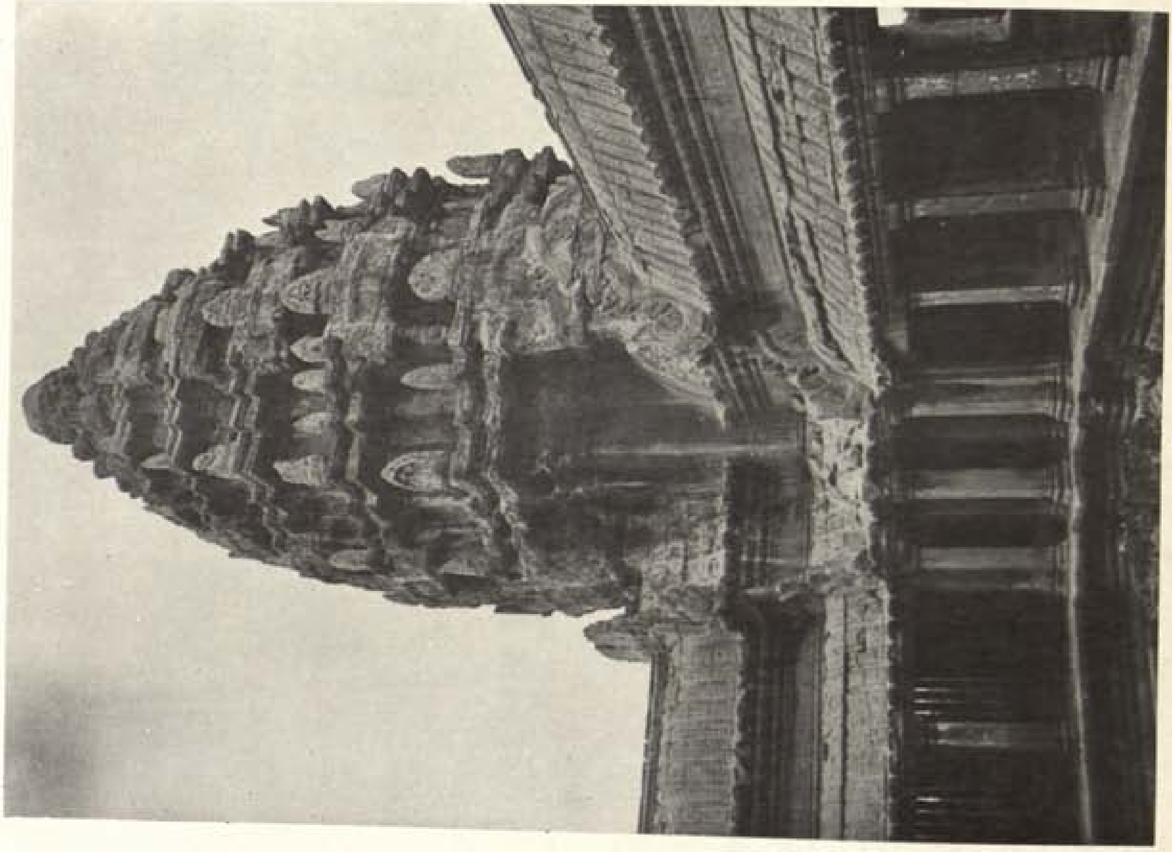


B

First Enclosure : north-west corner tower, A, before and B, after conservation and chemical treatment

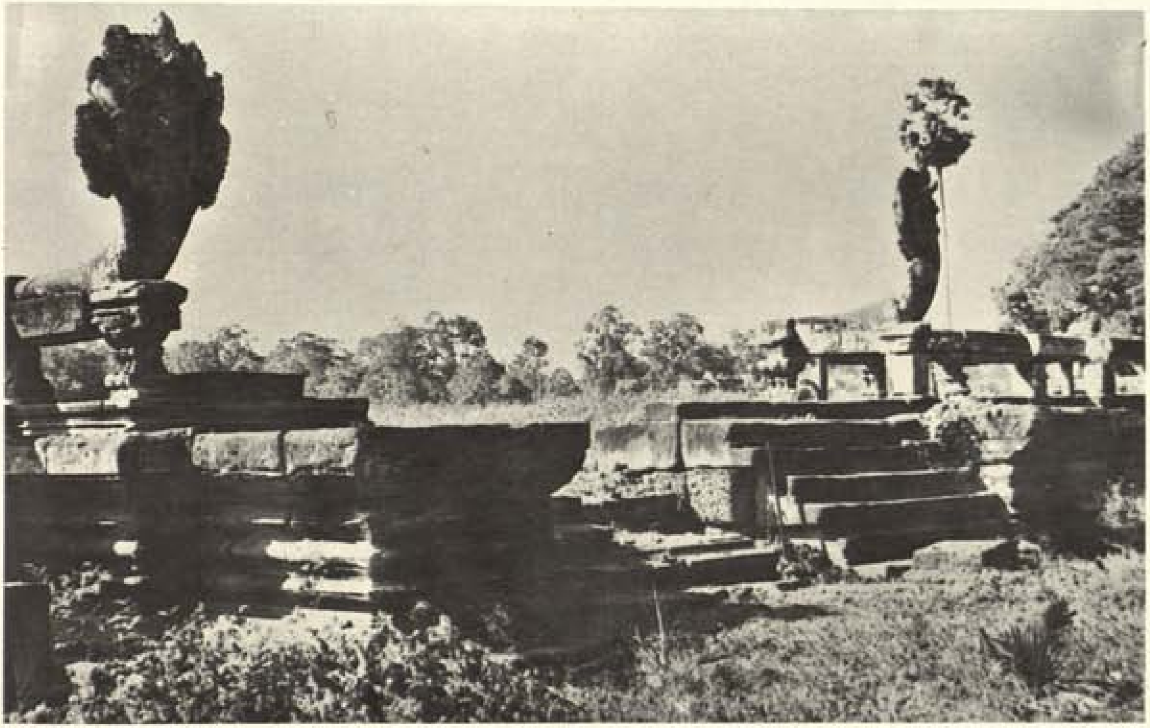


A



B

First Enclosure : south-west corner tower, A, before and B, after conservation

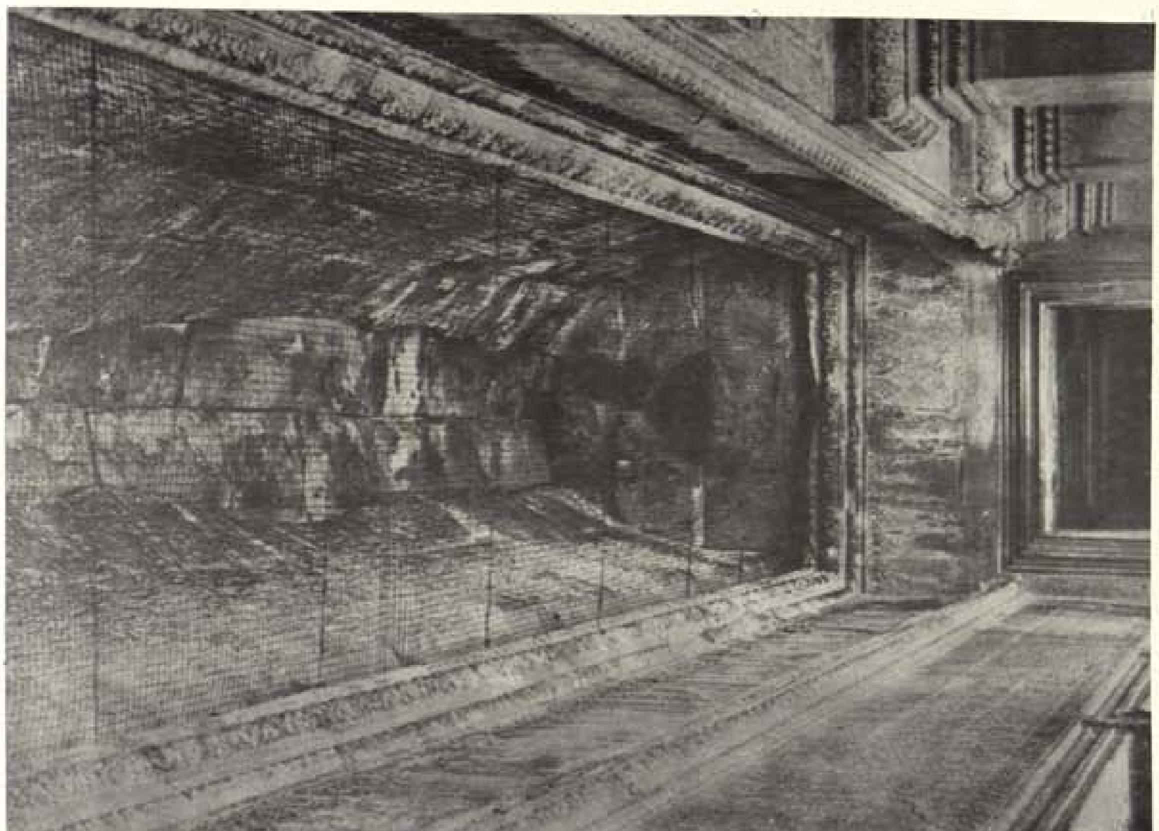


A

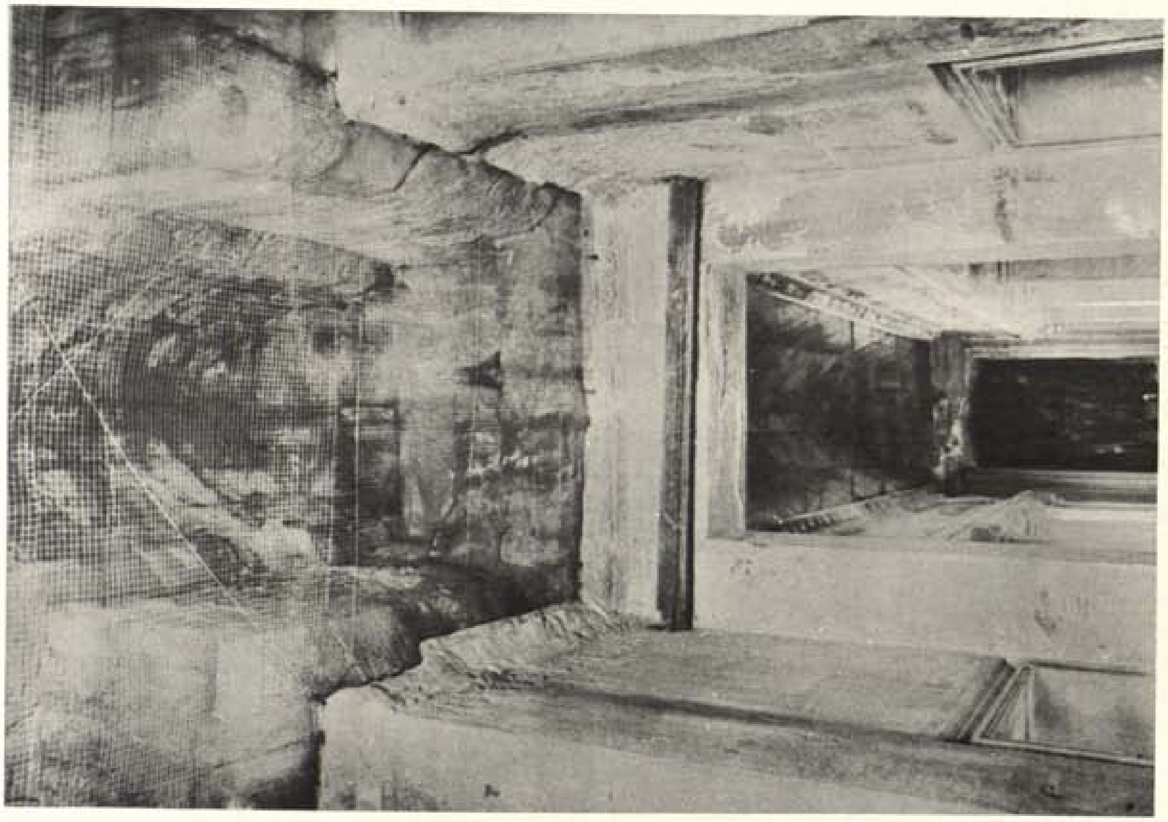


B

Railing between Third and Fourth Enclosures : stepped entrance at north-west corner, A, before and B, after conservation

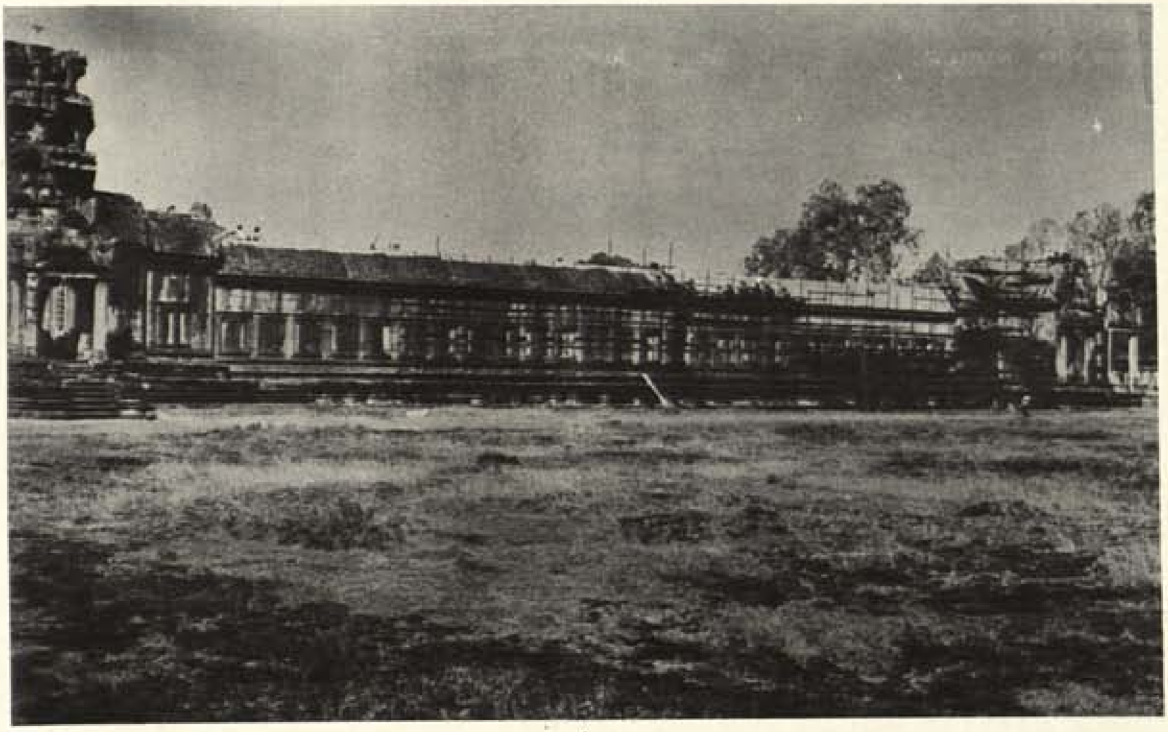


A

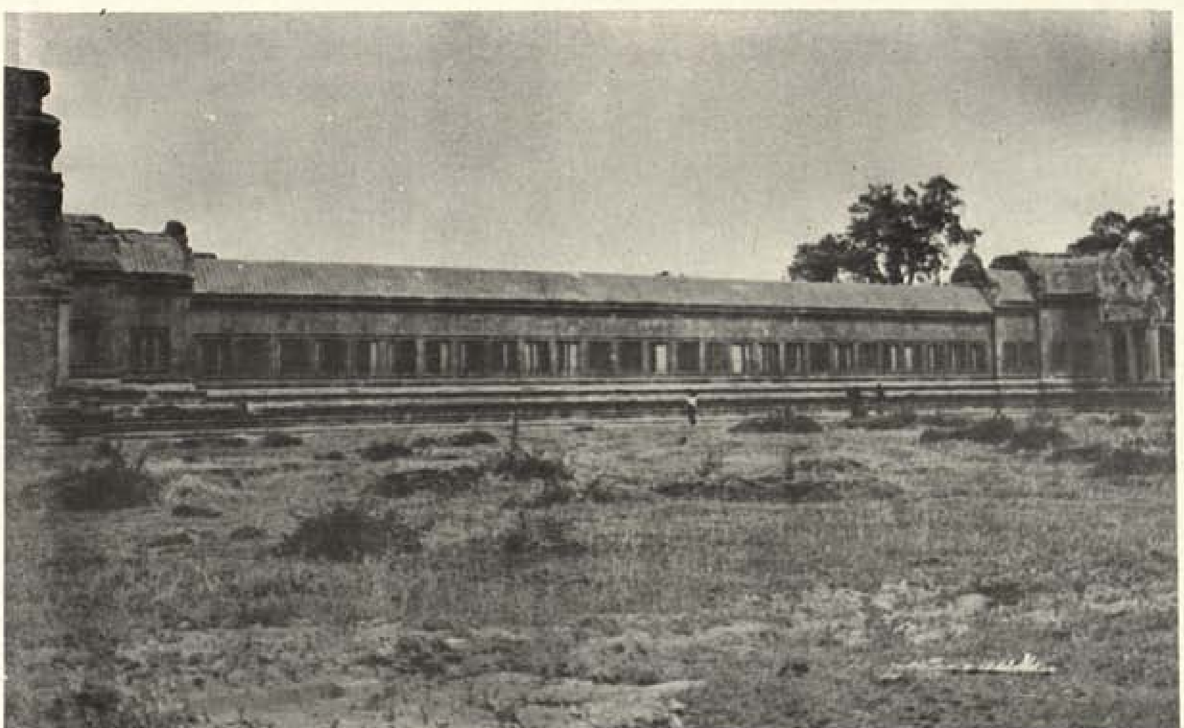


B

First Enclosure : galleries provided with welded mesh

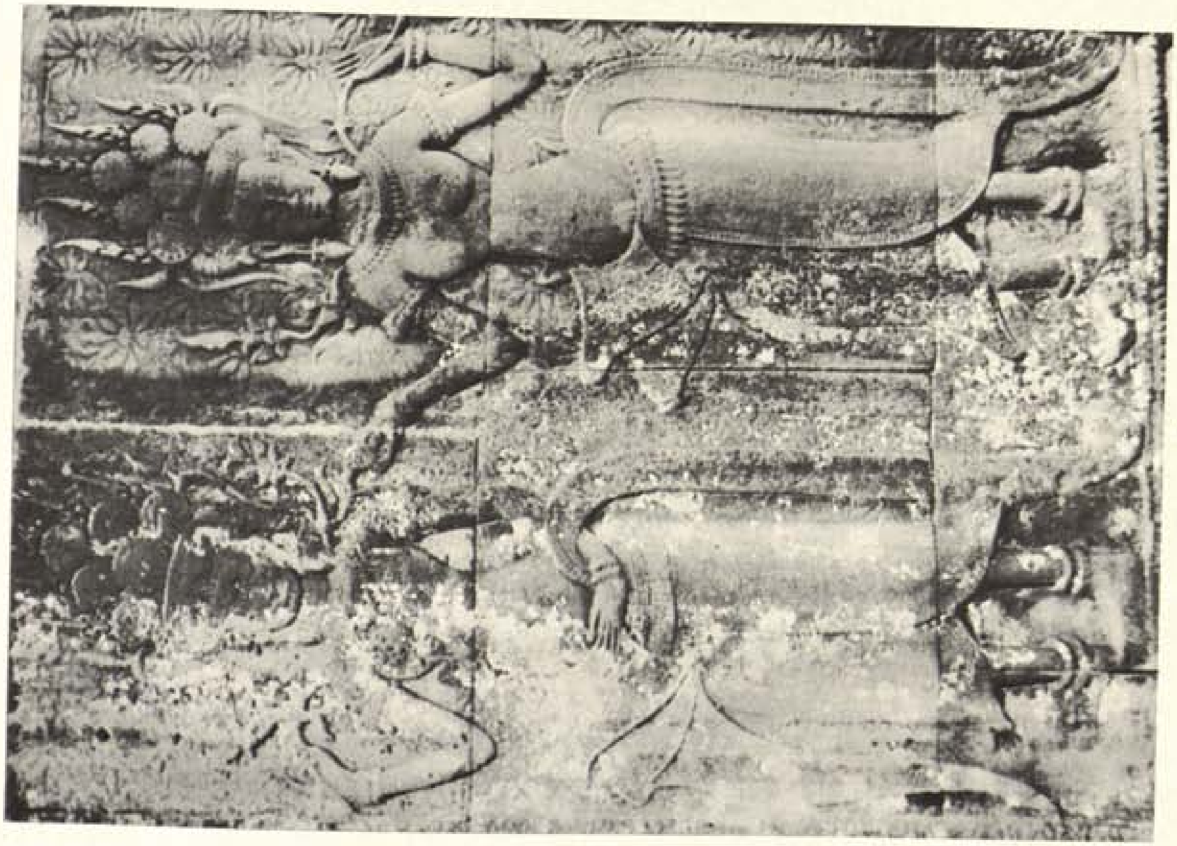


A

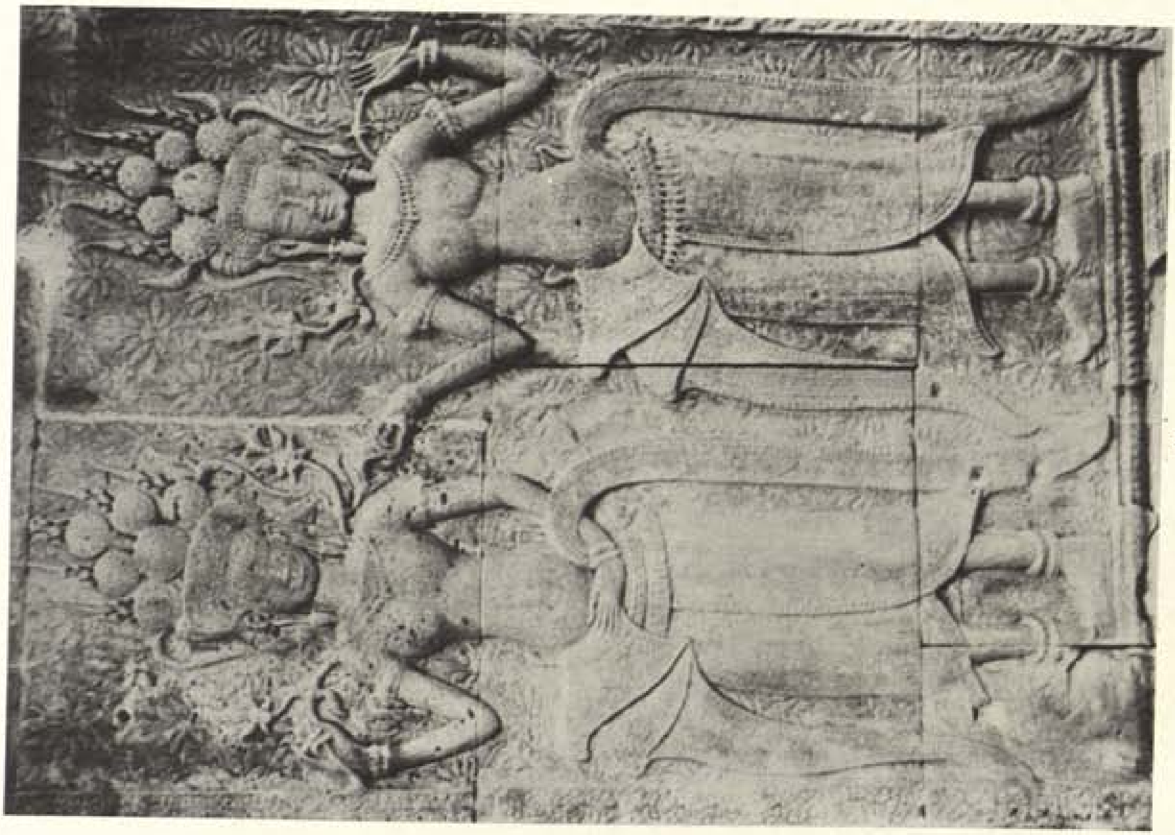


B

Fourth Enclosure: *Western Gateway*, A, *before and* B, *after chemical treatment*



A



B

Fourth Enclosure : Western Gateway, apsaras, A, before and B, after chemical treatment

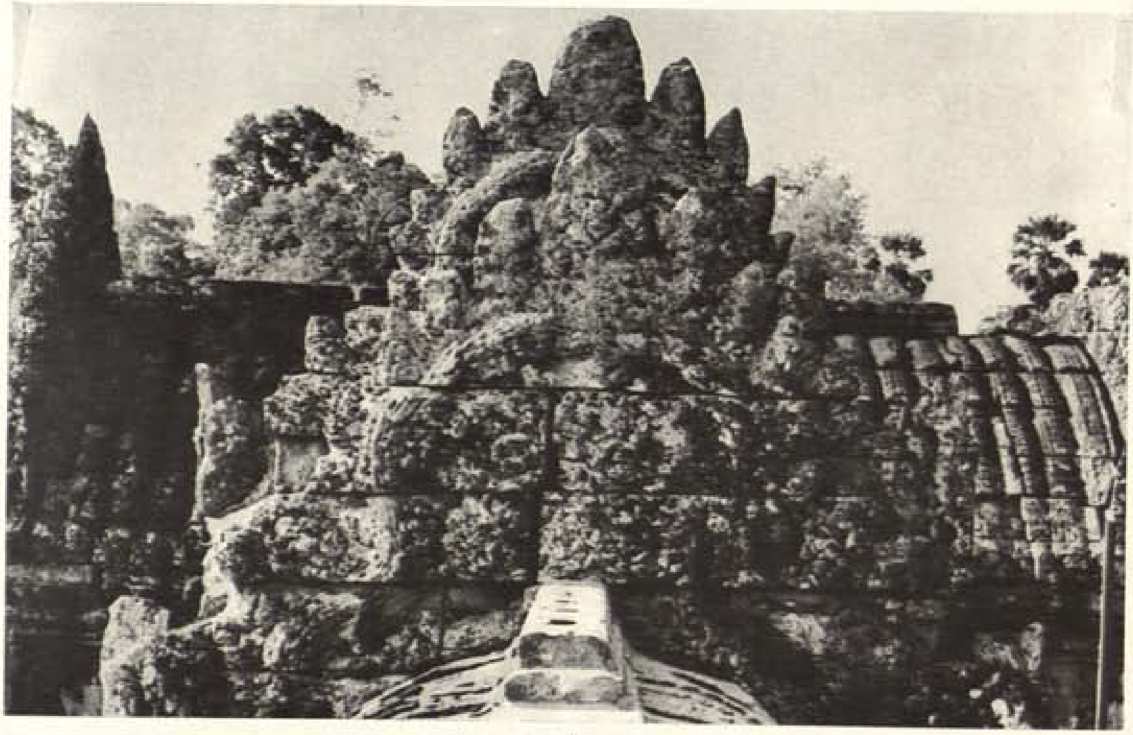


B



A

Fourth Enclosure : Western Gateway, apsaras, A, *before and* B, *after chemical treatment*



A



B

Fourth Enclosure : Western Gateway, a torana on the roof, A, *before and* B, *after conservation and chemical treatment*



A



B

Third and First Enclosures : *towers and enclosures*, A, *before and* B, *after chemical treatment*



A



B

Esplanade and Third and First Enclosures, A, *before and* B, *after chemical treatment*



A



B

Third Enclosure : *Southern Gallery on western side*, A, *before and* B, *after chemical treatment*

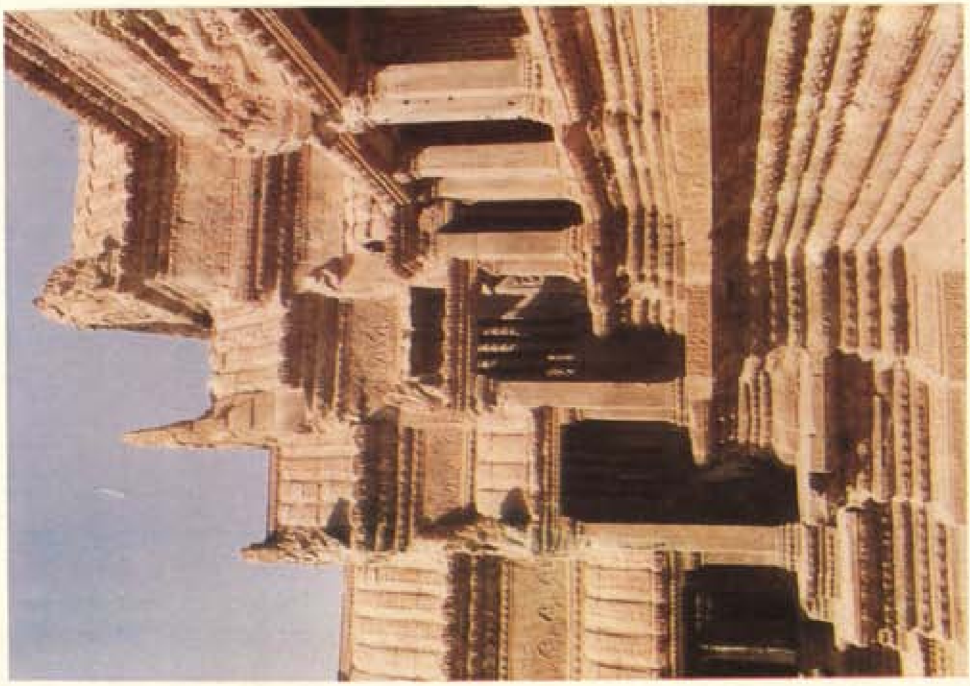


A

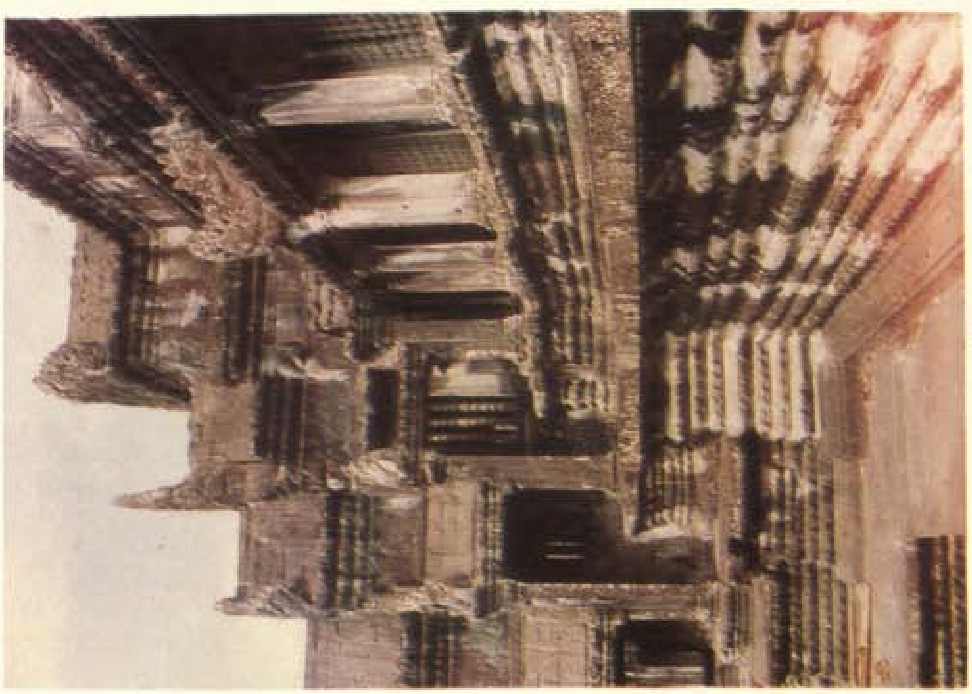


B

Third Enclosure : *Northern Gallery on western side*, A, *before and* B, *after conservation and chemical treatment*



B

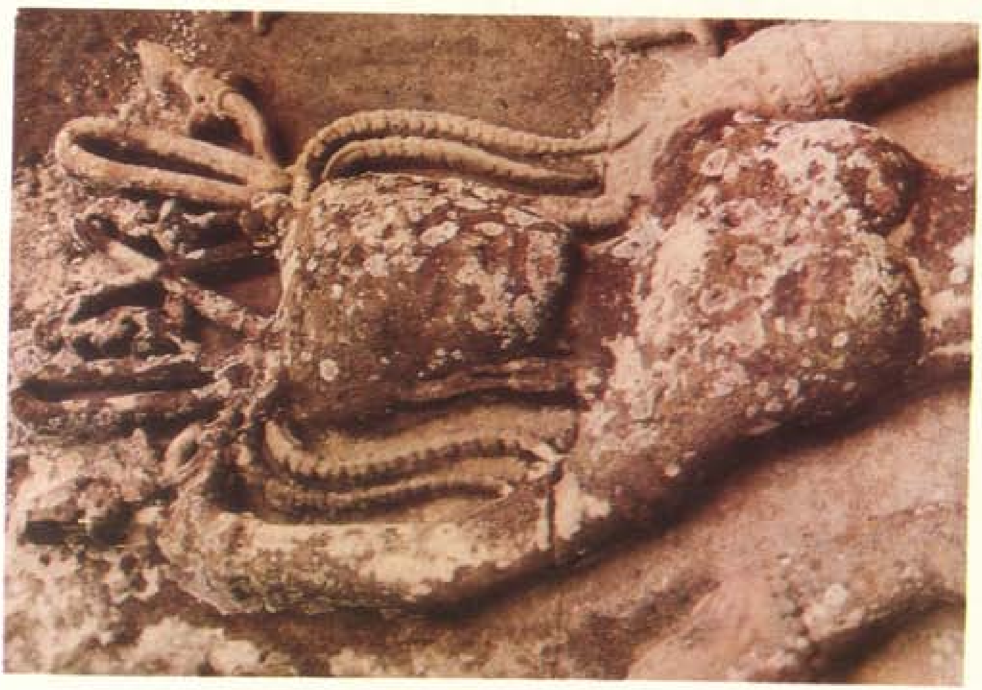


A

Antechamber : galleries, A, before and B, after chemical treatment

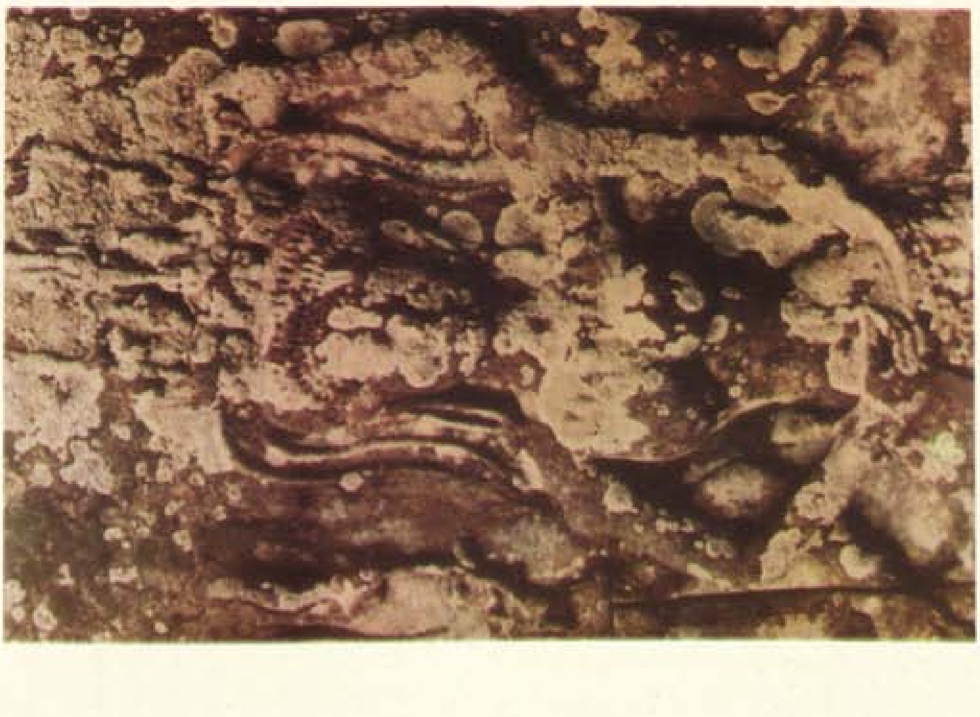


B



A

Second Enclosure : apsara, A, *before and* B, *after chemical treatment*



A



B

Second Enclosure : apsara, A, *before and* B, *after chemical treatment*



A



B

Library between Second and Third Enclosures : apsaras, A, before and B, after chemical treatment